# PATENT ABSTRACTS OF JAPAN

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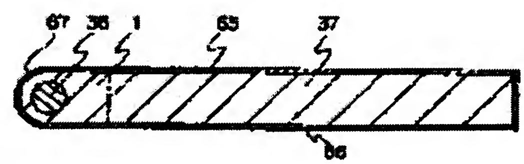
(71)Applicant : HITACHI LTD

(72)Inventor : KIMURA HAJIME

## (54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PURPOSE: To increase the quantity of light from a fluorescent tube which is made incident on a light transmission plate so as to improve the efficiency of the utilization of the light by providing a light condensing part constituted of a solid medium around the fluorescent tube and providing the light transmission plate succeeding the light condensing part.




CONSTITUTION: The light condensing part 1 constituted of a light transmission body made of, for example, acrylic resin, etc., is closely provided around the fluorescent tube 36, and the light condensing part 1 is integrally formed with the light transmission plate 37. The light outgoing from the tube 36 is made incident on the plate 37 directly or after being reflected by a lamp reflecting cover 67. The light which is not totally reflected out of the made incident on the plate 37 and reaching an upper surface is emitted from the upper surface through a diffusion sheet 65 so as to supply the light to a liquid crystal display element arranged above the plate 37. The direction of the light is controlled to be directed to the plate 37 by gradually changing the refractive index of the light condensing part 1, so that the light is reduced which is emitted from the tube 36 and then returned to the tube 36 again by being reflected by the cover 67.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is arranged under a liquid crystal display component, carries out the light guide of the light of fluorescence tubing which is the light source, and relates to the liquid crystal display which has the back light which grows into a liquid crystal display component including the light guide plate which supplies light.
[0002]
[Description of the Prior Art] A liquid crystal display by for example, the sealing compound which separated predetermined spacing and prepared two transparence glass substrates in the perimeter of an edge between superposition and both substrates so that the field which carried out the laminating of the pixel electrode which consists of the transparence electric conduction film, the orientation film, etc. might counter, respectively The liquid crystal display component which closes liquid crystal among both substrates while sticking both substrates, prepares a polarizing plate in the outside of both substrates, and grows into it further (liquid crystal display panel), It is arranged under a liquid crystal display component, and is constituted including the back light which supplies light to a liquid crystal display component, the circuit board which drives a liquid crystal display component.
[0003] a back light leads the light emitted from the light source to the one distant from the light source, and changes from synthetic-resin plates, such as an acrylic of the transparence for irradiating light at homogeneity, to the whole liquid crystal display component -- with a rectangular parallelepiped-like light guide plate mostly It covers covering an overall length mostly. fluorescence tubing which is the light source arranged to this side face and parallel along this side face near the side face of a light guide plate, and fluorescence tubing -- the -- a cross-section configuration by the shape of about U characters It consists of lamp reflective covering returned to a light guide plate so that light of fluorescence tubing may not be leaked outside, a diffusion sheet which is arranged on a light guide plate and diffuses the light from a light guide plate, and a reflective sheet which is arranged under a light guide plate and made to reflect the light from a light guide plate in the direction of a liquid crystal display component. Moreover, although the light guide of the light which carried out incidence into the light guide plate from fluorescence tubing is carried out, carrying out total reflection of the inside of a light guide plate, in order to carry out outgoing radiation of it from the top face of a light guide plate by diffuse reflection, the white ink dot pattern by printing for two or more optical diffusion or this base, the hole of one, a slot, and heights are formed in the base of a light guide plate so that light can irradiate homogeneity. For example, in the case of the ink dot, it has printed so that the area of an ink dot may become large, as it separates from the light source. Thereby, a uniform light is irradiated also in a location distant from the light source also in a near location. Moreover, there is also a back light of the so-called direct female mold which is arranged under two or more fluorescence tubing arranged by parallel through the diffusion plate, respectively under the liquid crystal display component and fluorescence tubing, and consists of reflecting plates made to reflect the light from fluorescence tubing in the direction of a liquid crystal display component.

[0004] Such a conventional liquid crystal display is indicated by JP,60-19474,B and JP,4-22780,U.
[0005]
[Problem(s) to be Solved by the Invention] In the conventional back light, space exists between fluorescence tubing, and a light guide plate and lamp reflective covering. When progressing between the media by which light differs, reflection of light and refraction take place there. The light which carried out outgoing radiation from fluorescence tubing which is the light source reflects with lamp reflective covering, and when going into a light guide plate from the air space which exists between fluorescence tubing and a light guide plate, light is refracted, and light reflects it by the end face (light entering surface) of the light guide plate while it carries out ON light. The reflected light will return to the direction of fluorescence tubing again, and will be absorbed. Therefore, efficiency for light utilization decreases.
[0006] Moreover, outgoing radiation is carried out from fluorescence tubing, and since the direction to which the beam of light reflected with lamp reflective covering goes is well uncontrollable, the light reflected with lamp reflective covering will return to the direction of fluorescence tubing again, and will be absorbed. Therefore, efficiency for light utilization decreases.
[0007] Moreover, when the light which carried out outgoing radiation from fluorescence tubing goes into the end surface for entering light of a light guide plate from the air space between fluorescence tubing and a light guide plate, in order that light may progress to "being dense" from a "non-dense" optically, a refraction optical refraction angle becomes small. Consequently, it increases, the inferior surface of tongue where the ink dot pattern was printed, and parallel, i.e., light which progresses horizontally, of light which carried out incidence to the light guide plate. Therefore, the light which reaches the end surface for entering light of a light guide plate and the end face which counters increases. Since the reflective sheet is prepared in the outside of this end face, it reflects by this end face, and the light which reached this end face arrives at an end surface for entering light again, comes out of a light guide plate, and is absorbed by fluorescence tubing. Therefore, efficiency for light utilization decreases.
[0008] Moreover, a capacitor is constituted by lamp reflective covering, fluorescence tubing, and the air space between both, and the current which flows fluorescence tubing tends to leak, therefore power consumption becomes large.
[0009] Moreover, the conventional lamp reflective covering which returns the light of fluorescence tubing to the direction of a light guide plate is constituted by the reflective sheet which established the reflector in the inside. That is, before attaching, it is a rectangle-like sheet, and the both ends are fixed to the edge of the top face of a light guide plate, and an inferior surface of tongue. Therefore, since it was space between fluorescence tubing and a reflective sheet, it was difficult to control and hold the configuration of the reflective sheet twisted around the perimeter of fluorescence tubing.
[0010] Furthermore, the both ends are inserted in the hole of a rubber bush, and fluorescence tubing is held. Therefore, the light by which outgoing radiation is carried out from fluorescence tubing to the direction of a rubber bush is absorbed by GOMUSSHU. Moreover, since a crevice is between lamp reflective covering and a rubber bush, light leaks from there. Therefore, efficiency for light utilization decreases.
[0011] The light of fluorescence tubing increases the amount of the light which carries out incidence to a light guide plate, and the amount of the light which carries out outgoing radiation from the top face of a light guide plate, and the 1st purpose of this invention has it in offering the liquid crystal display which can improve the use effectiveness of light.
[0012] The 2nd purpose of this invention decreases the amount from which the current which flows in fluorescence tubing leaks outside, and is to offer the liquid crystal display which can reduce power consumption.
[0013] The 3rd purpose of this invention is to offer the liquid crystal display which can improve the controllability of the travelling direction of light reflected with the light and lamp reflective covering which could form the configuration of lamp reflective covering correctly, and could hold it, and carried out outgoing radiation from fluorescence tubing.

[0014] The 4th purpose of this invention is to prevent that prevent that light is absorbed in respect of the fluorescence tubeside of holders, such as a rubber bush holding fluorescence tubing, and light leaks from the crevice between lamp reflective covering and a holder, and offer the liquid crystal display which can improve efficiency for light utilization.

[0015]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention offers the structure where the perimeter of fluorescence tubing which is the light source was covered by the solid medium, i.e., a transparent material. Moreover, the structure where the refractive index of the medium of the condensing section which consists fluorescence tubing of a wrap transparent material has a location dependency is offered. Moreover, the cavity of a predetermined configuration is prepared between the condensing sections and fluorescence tubing which consist of a transparent material, and the structure which controls the direction to which the light in which outgoing radiation is carried out by the configuration of this cavity from fluorescence tubing goes is offered. Moreover, the structure which prepared lamp reflective covering with which the configuration was formed correctly in the perimeter of fluorescence tubing is offered by covering the perimeter of fluorescence tubing by the solid medium. Furthermore, the structure which established the reflector in the field of the fluorescence tubeside holding fluorescence tubing of a holder, or prepared the reflector between a holder and lamp reflective covering is offered.

[0016] That is, this invention is characterized by having been arranged under a liquid crystal display component, having carried out the light guide of the light of fluorescence tubing, and having prepared the condensing section which changes from a solid medium to the perimeter of said fluorescence tubing in the liquid crystal display which has the back light which grows into said liquid crystal display component including the light guide plate which supplies light, and preparing said light guide plate succeeding said condensing section.

[0017] Moreover, it is characterized by the end surface for entering light of said light guide plate and the major axis of said fluorescent lamp being almost parallel.

[0018] Moreover, it is characterized by preparing the condensing section which consists of a transparent material in the perimeter except the both ends of said fluorescence tubing.

[0019] Moreover, it is characterized by fitting in and forming said fluorescence tubing in the long and slender through hole prepared in said condensing section.

[0020] Moreover, it is characterized by forming the cavity of the configuration formed so that the direction where the light of said fluorescence tubing progresses between said condensing sections and said fluorescence tubing might be controlled.

[0021] Moreover, it is characterized by adjusting the refractive index of each part of said condensing section so that the light guide of the light of said fluorescence tubing may be carried out to the direction of said transparent material.

[0022] Moreover, it is characterized by adjusting greatly gradually as said light guide plate is approached [ refractive index / of each part of said condensing section ] in the light of said fluorescence tubing so that a light guide may be carried out to the direction of said transparent material.

[0023] Moreover, it is characterized by having covered without the crevice lamp reflective covering which established the reflector in the inside on the outside of said condensing section, and preparing it in it.

[0024] Moreover, it has the holder which has the crevice which fits into said both ends of said fluorescence tubing, and is characterized by establishing a reflector in the field of said fluorescence tubeside of said holder.

[0025] Furthermore, it has the holder which has the crevice which fits into said both ends of said fluorescence tubing, and is characterized by preparing a reflector for the field of said fluorescence tubeside of said holder, and the outside of said condensing section between wrap lamp reflective coverings.

[0026]

[Function] In this invention, if the light which carried out outgoing radiation from fluorescence tubing

which is the light source returns to fluorescence tubing again, some will be absorbed with fluorescence tubing. I want to reduce a lost part of a there if possible. Returning to fluorescence tubing has what reflects and returns with lamp reflective covering, and the thing which reflects and returns by the incidence end face of a light guide plate. The reflection by the incidence end face of a light guide plate originates in the difference in the refractive index of an air space and a light guide plate. So, by this invention, fluorescence tubing is covered by the solid medium, i.e., a transparent material, (this part is called the condensing section). That is, in the former, although there was a reflective component, since the air space between the condensing section around fluorescence tubing and a light guide plate can be lost according to the difference of the refractive index of an air space and a light guide plate by covering fluorescence tubing by the transparent material, and unifying this condensing section and light guide plate, the difference of a refractive index does not arise, but light returns to fluorescence tubing, and the amount absorbed by fluorescence tubing decreases.

[0027] Moreover, since light goes to the one where a refractive index is larger, it can give a location dependency to the refractive index of the medium of the wrap condensing section for fluorescence tubing, it can enlarge it gradually as it changes a refractive index and faces to a light guide plate by the location, and can lead light to a light guide plate efficiently towards a direction to lead light. In order to give a location dependency to a refractive index, the refractive index of the condensing section may be changed gradually and several layers may be changed stair-like.

[0028] Moreover, the cavity where air exists fluorescence tubing and it between wrap media can be prepared, and the direction of a beam of light can be controlled by the configuration of the cavity. This is the same as the direction of a solid medium using that light goes to the one where a refractive index is larger since the refractive index is large, and giving a location dependency to the refractive index of the transparent material around fluorescence tubing rather than air.

[0029] Optically light as mentioned above in order to progress to "being dense" from a "non-dense" moreover, in the former Since a refraction optical refraction angle becomes small, the light which carried out incidence to the end face of a light guide plate from the air space Then, there were many amounts which it becomes light with a certain limited angle of refraction, becomes easy to turn to light horizontally, reflect refraction incident light by the end face opposite to this incidence end face by it, and are returned and absorbed by fluorescence tubing. However, in this invention, since there is no boundary of an air space and the incidence end face of a light guide plate, this amount absorbed can be decreased.

[0030] Moreover, since insulation is higher than the air space between the conventional fluorescence tubing and lamp reflective covering in fluorescence tubing by this invention, by a capacitor consisting of fluorescence tubing, lamp reflective covering, and an air space, the medium of a wrap solid-state can lessen the amount from which the current which flows fluorescence tubing leaks, and can reduce power consumption.

[0031] Moreover, by forming the appearance of the condensing section which consists fluorescence tubing of this solid-state medium by the solid medium for a wrap reason in a predetermined configuration, the configuration of lamp reflective covering surrounding the perimeter of fluorescence tubing can be decided easily, and it can fix. Therefore, it is also easy to form lamp reflective covering in a complicated configuration.

[0032] Furthermore, by establishing a reflector in the field of the fluorescence tubeside holding fluorescence tubing of a rubber bush, or preparing a reflector between a rubber bush and lamp reflective covering, it can prevent that light is absorbed by the rubber bush, and can control that light leaks from the crevice between lamp reflective covering and a rubber bush, and efficiency for light utilization can be improved.

[0033]

[Example] Drawing 1 is the sectional view showing the back light of the liquid crystal display of one example of this invention. The diffusion sheet with which a light guide plate and 36 had been arranged at fluorescence tubing, and 65 has been arranged for 37 on the top face of a light guide plate 37, the reflective sheet with which 66 has been arranged on the inferior surface of tongue of a light guide plate 37, and 67 are lamp reflective coverings. It consists of sheets of one sheet with common lamp reflective

covering 67 and reflective sheet 66. Moreover, the reflective sheet is prepared also in two side faces of the light guide plate 37 which is not illustrated here. 1 is the condensing section formed in the perimeter of the fluorescence tubing 36 at a light guide plate 37 and one. In addition, the ink dot pattern prepared in the inferior surface of tongue of a light guide plate 37 by printing here (it does not restrict to this.) Also in an inferior surface of tongue, the hole formed in one, a slot, heights, etc., it contains. the following -- being the same -- the illustration abbreviation has been carried out. That is, the condensing section 1 which consists of transparent materials, such as an acrylic, is formed in the perimeter of the fluorescence tubing 36 without a crevice, and the condensing section 1 and a light guide plate 37 are formed in one. A through hole long and slender to the end surface for entering light of a light guide plate 37 and parallel is prepared in the condensing section 1, and the fluorescence tubing 36 is inserted and held in this. Moreover, the lamp reflective covering 67 is covered that there is no crevice in the outside of the condensing section 1 formed in the predetermined appearance which consists of the transparent material around the fluorescence tubing 36, for example, is being fixed by the binder. Moreover, the heights and the crevice corresponding to the condensing section 1 or a light guide plate 37, and the lamp reflective covering 67 may be formed, doubled and inserted in, respectively, and you may fix. Furthermore, on the front face of the condensing section 1 or a light guide plate 37, by carrying out vacuum deposition of silver, the aluminum, etc., a reflector may be formed and lamp reflective covering 67 the very thing may be constituted.

[0034] After reflecting with the direct or lamp reflective covering 67, incidence of the light which carried out outgoing radiation from the fluorescence tubing 36 which is the light source is carried out to a light guide plate 37. Outgoing radiation of what carries out incidence to a light guide plate 37, and does not carry out total reflection among the light which arrived at the top face is carried out through the diffusion sheet 65 from there, and it supplies light to the liquid crystal display component (the liquid crystal display part of the liquid crystal display component 62 of drawing 12 which is actually visible from outside, i.e., a visible region) which is arranged on a light guide plate 37 and which is not illustrated. Moreover, diffuse reflection of the light which shone upon the ink dot pattern printed by the inferior surface of tongue of a light guide plate 37 is carried out there, and it arrives at a top face and carries out outgoing radiation through the diffusion sheet 65. Although the light which carried out incidence from the incidence end face of a light guide plate carried out total reflection according to the difference of the refractive index by the difference in the medium of an air space and a light guide plate and did not carry out outgoing radiation from the top face of a light guide plate 37 conventionally unless the ink dot pattern was hit In this example, the consistency of the ink dot pattern for a certain reason whose light which does not carry out total reflection also opens even to the visible region of a display, the reflector 67, i.e., lamp reflective covering, of a light guide plate 37 on top, and prints it on the inferior surface of tongue of the light guide plate 37 near the fluorescence tubing 36 is made small.

[0035] However, even in this case, outgoing radiation is carried out from the fluorescence tubing 36, it reflects with the lamp reflective covering 67, and there is light again returned and absorbed by the fluorescence tubing 36. Then, to be shown in drawing 2 (for an arrow head to show the light which carries out outgoing radiation from the fluorescence tubing 36), the refractive index of the condensing section 1 which consists of the transparent material around the fluorescence tubing 36 is adjusted, and the direction of light is controlled. That is, since light goes to the one where a refractive index is larger, it is made to decrease the light (explains a concrete configuration later using drawing 5 , and 6 and 7) by changing the refractive index of the condensing section 1 gradually and from which the direction of a beam of light is controlled to go to the direction of a light guide plate 37, the light of the fluorescence tubing 36 reflects with the lamp reflective covering 67, and it returns to the fluorescence tubing 36 again.

[0036] It is made to be the following in order to change the refractive index of the medium of the solid-state around the fluorescence tubing 36. Drawing 3 (a) and (b) are drawings showing the relation between a distance radial [ from the core 68 of the fluorescence tubing 36 / r ], and the refractive index of the medium around the fluorescence tubing 36 (condensing section 1 of drawing 1 ). That is, a coordinate 69 is taken for the core 68 of the fluorescence tubing 36 from there to radial [ r ] for the zero

of a graph. A continuous line 70 shows the example which enlarges the refractive index gradually as it separates from the fluorescence tubing 36. Although it is easy to carry out outgoing radiation of the light by enlarging a refractive index gradually towards the exterior from the front face of the fluorescence tubing 36 from the fluorescence tubing 36 since the reason for enlarging a refractive index such gradually goes to the one where light of a refractive index is larger, light cannot progress in the direction which returns to the smaller one 36, i.e., fluorescence tubing, from the one where a refractive index is larger easily. Therefore, the amount of the light which carries out outgoing radiation from the fluorescence tubing 36, reflects by the inside of the lamp reflective covering 67, and returns to the fluorescence tubing 36 again can be decreased. In addition, on manufacture, when difficult, enlarging gradually the refractive index of the medium of the solid-state around the fluorescence tubing 36, as shown in a continuous line 70 may change a refractive index stair-like by piling up the medium of the solid-state of the same refractive index in the shape of a layer, as shown in a broken line 71.

[0037] Drawing 4 (a) and (b) are drawings showing the relation between the distance of the horizontal direction x from the end face 72 of a light guide plate 37, and the refractive index of the medium around the fluorescence tubing 36 (condensing section 1). A coordinate 73 is taken for the end face 72 of a light guide plate 37 from there to a horizontal direction x for the zero of a graph. A continuous line 74 shows the example which enlarges the refractive index gradually as it separates from the fluorescence tubing 36. The reason for enlarging a refractive index such gradually By enlarging a refractive index gradually towards the direction of the light guide plate 37 which is a display from the front face of the fluorescence tubing 36, since light goes to the one where a refractive index is larger The amount of the light which carries out outgoing radiation from the top face of the diffusion sheet 65 (refer to drawing 1 ) can be increased, and it reflects with the lamp reflective covering 67, or reflects by the end face opposite to the incidence end face of a light guide plate 37, and the amount of the light which returns to the fluorescence tubing 36 again can be decreased. In addition, on manufacture, when difficult, enlarging gradually the refractive index of the medium of the solid-state around the fluorescence tubing 36, as shown in a continuous line 74 may change a refractive index stair-like by piling up the medium of the solid-state of the same refractive index in the shape of a layer, as shown in a broken line 75.

[0038] However, both of drawing 3 and drawing 4 are one-dimension talks, and in practice, combining drawing 3 and drawing 4 , by changing the refractive index of the condensing section 1 two-dimensional so that both sides may be satisfied, they are controlled so that a beam of light progresses, as shown in drawing 2 .

[0039] The concrete example to which the medium of the solid-state of the same refractive index changed the refractive index of the condensing section 1 stair-like in piles in the shape of a layer is shown in the sectional view of drawing 5 , drawing 6 , and drawing 7 . The figure of 1-5 in the condensing section 1 and the light guide plate 37 of drawing 5 and drawing 6 and the figure of 1-7 of drawing 7 show the refractive index of each part, and show that a refractive index is so large that a figure is large. In addition, drawing 5 -7 are instantiation to the last, and, in addition to this, a number of layers, a configuration, and a configuration are considered variously.

[0040] Furthermore, in the semantics of changing the refractive index of the medium around the fluorescence tubing 36, air is also one of the media. Then, to be shown in drawing 8 , a cavity 76 may be formed between the perimeters of the fluorescence tubing 36, i.e., the fluorescence tubing 36 and the condensing section 1, and how a beam of light progresses using the difference in the refractive index of the air space in the cavity 76 of a predetermined configuration and the condensing section 1 may be controlled. That is, the direction to which a beam of light goes is controlled by the condensing section 1 which consists of a configuration of the air space in the cavity 76 which is the medium of the gas around the fluorescence tubing 36, and a solid medium. Since the light by which outgoing radiation is carried out from the fluorescence tubing 36 goes to the one where a refractive index is larger, it cannot return to the direction of the fluorescence tubing 36 easily due to existence of an air space. This example also does so the same operation as drawing 2 - drawing 7 , and effectiveness. That is, the amount of the light which carries out outgoing radiation from the fluorescence tubing 36, reflects with the lamp reflective covering 67, and returns to the fluorescence tubing 36 again can be decreased. In addition, you may

control on a phase target gradually [ the refractive index of the medium of the solid-state of the condensing section 1 of drawing 8 ].
[0041] In addition, the quality of the material of a light guide plate 37 can use an acrylic etc., and can use an acrylic etc. similarly [ the medium of the solid-state of the condensing section 1 ]. In order to unify a light guide plate 37 and the condensing section 1, after forming both separately, you may paste up using a binder etc. or may form by injection molding etc. as a thing of one from the beginning.
[0042] Moreover, the configuration of the outside of the condensing section 1 and the configuration of the lamp reflective covering 67 prepared in the outside are not limited to the configuration shown in drawing 1 - drawing 8 . For example, it can also form in a complicated configuration as shown in drawing 9 .
[0043] Moreover, before attaching the conventional lamp reflective covering as mentioned above, it is the reflective sheet of the shape of a rectangle which established the reflector in the inside, and fixes the both ends to the edge of the top face of a light guide plate, and an inferior surface of tongue. Therefore, since it was space between fluorescence tubing and a reflective sheet, it was difficult to control and hold the configuration of the reflective sheet twisted around the perimeter of fluorescence tubing. However, with the configuration shown in above-mentioned drawing 1 - drawing 9 , since the perimeter of the fluorescence tubing 36 is enclosed by the condensing section 1 which consists of a solid medium, by covering the lamp reflective covering 67 on the outside of the condensing section 1 without a crevice, and preparing it in it from a reflective sheet etc., it can determine the configuration of the lamp reflective covering 67 easily, and can be fixed. Moreover, the configuration of the outside of the medium of the solid-state of the condensing section 1 can be formed according to the configuration of the lamp reflective covering 67 to form and it can realize easily by covering the lamp reflective covering 67 on the outside without a crevice, and preparing it in it to form in a complicated configuration as shows the configuration of the lamp reflective covering 67 to drawing 9 .
[0044] Moreover, although the current is flowing the inside of it when the fluorescence tubing 36 emits light, the current will leak outside through the lamp reflective covering 67. In short, capacity arises by the insulating layer between the fluorescence tubing 36, the lamp reflective covering 67, and both, and a current leaks from there. Conventionally, although the medium between the fluorescence tubing 36 and the lamp reflective covering 67 was air, in the above-mentioned example, the media between the fluorescence tubing 36 and the lamp reflective covering 67 are solid-state media, such as an acrylic, (at the example of drawing 8 , they are an air space and a solid-state medium), and since insulation is higher than air, an acrylic etc. can decrease the leakage current.
[0045] Moreover, drawing 10 is the perspective view showing the back light of another example of this invention. Lamp reflective covering with which in 37 fluorescence tubing and 1 were prepared in the condensing section, and a light guide plate and 36 prepared 67 in the perimeter of the condensing section 1, the rubber bush for fluorescence tubing maintenance which has the crevice where 77 fits into the both ends of the fluorescence tubing 36, and 78 are the reflectors established in the field by the side of the fluorescence tubing 36 of the rubber bush 77.
[0046] Conventionally, the field by the side of the fluorescence tubing 36 of the rubber bush 77 is not a reflector. Therefore, the light by which outgoing radiation is carried out from the fluorescence tubing 36 is absorbed in respect of the fluorescence tubing 36 side of the rubber bush 77, and light loses. So, in the example of drawing 10 , since the light absorbed in the rubber bush 77 will be reflected conventionally in a reflector 78 and it will not be absorbed by establishing a reflector 78 in the field by the side of the fluorescence tubing 36 of the rubber bush 77, efficiency for light utilization improves. The same configuration as the above-mentioned lamp reflective covering 67 is sufficient as a reflector 78, for example, it vapor-deposits and constitutes silver, aluminum, etc. in a sheet, a silver aluminum plate or the condensing silver section 1, or the rubber bush 77.
[0047] Moreover, as shown in drawing 10 , a crevice is between the rubber bush 77 and the lamp reflective covering 67. Therefore, leakage and light lose [ the light by which outgoing radiation is carried out from the fluorescence tubing 36 ] from this crevice. So, in the example of drawing 11 , a crevice is lost by forming the reflector 79 formed with the reflective sheet etc. between the rubber bush

77 and the condensing section 1 (or lamp reflective covering 67) (a reflector being formed in the lamp reflective covering 67 side at least), and conventionally, since the light which had leaked from the above-mentioned crevice is reflected by the reflector 79, efficiency for light utilization improves.

[0048] Since the direction of the beam of light by which outgoing radiation is carried out from the fluorescence tubing 36 in each above-mentioned example by the medium formed in the perimeter of the fluorescence tubing 36 is controllable as explained above and the amount of the light which returns to the fluorescence tubing 36 again and is absorbed by the fluorescence tubing 36 can be decreased, efficiency for light utilization can be improved. Therefore, the brightness of a back light improves, the display screen becomes bright and display quality improves. Moreover, since solid-state media, such as an acrylic, are formed in the perimeter of the fluorescence tubing 36, the insulation around the fluorescence tubing 36 can become good, therefore the leakage current of the fluorescence tubing 36 can be decreased, and power consumption can be reduced. Moreover, since the perimeter of the fluorescence tubing 36 is covered by the solid-state medium, the configuration of the reflector of the lamp reflective covering 67 can be made into a complicated configuration. Efficiency for light utilization can be improved also by this. Furthermore, by establishing a reflector 78 in the field by the side of the fluorescence tubing 36 of the rubber bush 77 holding the fluorescence tubing 36, or forming a reflector 79 between the rubber bush 77 and the lamp reflective covering 67, it can control that prevent that light is absorbed by the rubber bush 77, or light leaks from the crevice between the lamp reflective covering 67 and the rubber bush 77, and efficiency for light utilization can be improved.

[0049] Drawing 12 is the decomposition perspective view showing the liquid crystal display module 63 of a passive matrix with which this invention summarized to one can apply the light source to a compact with the liquid crystal display component 62 and the drive circuit for driving this liquid crystal display component 62. IC34 which drives the liquid crystal display component 62 is carried in the printed circuit board 35 of the frame-like object equipped with the window part for inserting in the liquid crystal display component 62 in the center. The printed circuit board 35 in which the liquid crystal display component 62 was inserted is inserted in the window part of the frame-like object 42 formed by plastics mold, puts the metal frame 41 on this, and fixes a frame 41 to a frame-like object 42 by bending the pawl 43 in the infeed 44 currently formed in the frame-like object 42.

[0050] The light guide plate 37 which consists of an acrylic board for making homogeneity irradiate the liquid crystal display cel 60 in the light from the cold cathode fluorescence tubing 36 arranged at the vertical edge of the liquid crystal display component 62 and this cold cathode fluorescence tubing 36, the reflecting plate 38 which applied the white coating to the metal plate and was formed, and the diffusion plate 39 of the opalescence which diffuses the light from a light guide plate 37 are inserted in that window part from the background of a frame-like object 42 in order of drawing 12 . The inverter power circuit (not shown) for turning on the cold cathode fluorescence tubing 36 is the crevice (not shown) established in the right-hand side back section of a frame-like object 42. It is in the location which counters the hollow 45 of a reflecting plate 38. It is contained. The diffusion plate 39, a light guide plate 37, the cold cathode fluorescence tubing 36, and a reflecting plate 38 are fixed by bending the tongue-shaped piece 46 prepared in the reflecting plate 38 in the small sum 47 in which it is prepared by the frame-like object 42.

[0051] The condensing section 1 which changes from a transparent material to the perimeter of two fluorescence tubing 36 is formed in a light guide plate 37 and one, it is adjusted so that the refractive index of each part of the condensing section 1 may carry out the light guide of the light of the fluorescence tubing 36 to the direction of a light guide plate 37, and efficiency for light utilization of the back light shown in this drawing is improving.

[0052] The block flow diagram of the laptop computer with which drawing 13 used the liquid crystal display module 63 for the display, and drawing 14 are drawings showing the condition of having mounted the liquid crystal display module 63 in the laptop computer 64. In this laptop computer 64, the liquid crystal display module 63 is driven for the result calculated by the microprocessor 49 by the semiconductor IC 34 for a liquid crystal drive through LSI48 for control.

[0053] Drawing 15 shows the array direction (for example, the direction of rubbing) of the liquid crystal

molecule on the electrode substrate at the time of seeing from the bottom the liquid crystal display component 62 of the liquid crystal display which can apply this invention, the direction of torsion of a liquid crystal molecule, the direction of a polarization shaft (or absorption shaft) of a polarizing plate, and the direction of an optical axis of the member which brings about the birefringence effectiveness, and drawing 16 shows the important section perspective view of the liquid crystal display component 62.

[0054] The direction 10 of torsion of a liquid crystal molecule and angle-of-torsion theta are prescribed by the class and amount of an optically active substance which are added by the nematic liquid crystal layer 50 which has the forward dielectric anisotropy pinched between the direction 6 of rubbing of the orientation film 21 on the upper electrode substrate 11, the direction 7 of rubbing of the orientation film 22 on the bottom electrode substrate 12 and the upper electrode substrate 11, and the bottom electrode substrate 12.

[0055] When [ transparent ] consisting of glass in order to carry out orientation so that a liquid crystal molecule may make distorted spiral structure between the bottom electrode substrate 11 and 12 on two sheets which pinch the liquid crystal layer 50 in drawing 16 for example, the approach of rubbing with cloth etc. the front face of the orientation film 21 and 22 which consists of organic macromolecule resin which touches for example, becomes the liquid crystal on the bottom electrode substrate 11 and 12 from polyimide to an one direction, and the so-called rubbing method are taken. In the direction of rubbing rubbed at this time, i.e., the direction, and the upper electrode substrate 11, the direction 7 of rubbing turns into the array direction of a liquid crystal molecule in the direction 6 of rubbing, and the bottom electrode substrate 12. Thus, give a gap d1 and the bottom electrode substrates 11 and 12 are made to counter on two sheets by which orientation processing was carried out, so that each direction 6 and 7 of rubbing may cross at 360 degrees from about 180 degrees mutually. the OFF chip section for pouring in liquid crystal for two electrode substrates 11 and 12 -- that is It pastes up by the sealing compound 52 of the shape of a frame equipped with the liquid crystal enclosure opening 51, and has a forward dielectric anisotropy in the gap, and if the nematic liquid crystal by which specified quantity addition was carried out in the optically active substance is enclosed, a liquid crystal molecule will carry out molecular arrangement of the spiral structure of angle-of-torsion theta in drawing between the electrode substrate. In addition, 31 and 32 are bottom electrodes, respectively, when [ transparent ] consisting of indium oxide or ITO (Indium Tin Oxide), for example. Thus, the member which brings the birefringence effectiveness to the upper electrode substrate 11 bottom of the constituted liquid crystal cell 60 (a birefringence member is called below.) the number for "phase contrast film for STN-LCD" magazine electronic ingredient February, 1991 besides Toson -- 40 [ page / 37 - 41st ] is arranged and the bottom polarizing plates 15 and 16 are further formed a top on both sides of this member 40 and liquid crystal cell 60.

[0056] Although angle-of-torsion theta of the liquid crystal molecule in liquid crystal 50 can take the value of the range of 180 to 360 degrees, if it carries out from a practical viewpoint of avoiding the phenomenon in which the lighting condition near the threshold of a transmission-applied-voltage curve serves as orientation scattered about in light from 200 degrees preferably although it is 300 degrees, and maintaining the outstanding time-sharing property, the range of 230 to 270 degrees is more desirable. Fundamentally, this condition acts so that the response of the liquid crystal molecule to an electrical potential difference may be made more sensitive and the outstanding time-sharing property may be realized. Moreover, in order to acquire the outstanding display quality, as for the refractive-index anisotropy deltan1 and the product deltan1 of thickness d1 of the liquid crystal layer 50, and d1, it is desirable to set 1.0 micrometers as the range of 0.6 to 0.9 micrometers more preferably from 0.5 micrometers.

[0057] The birefringence member 40 acts so that the polarization condition of the light which penetrates a liquid crystal cell 60 may be modulated, and that only whose colored display was completed is changed into a monochrome display in liquid crystal cell 60 simple substance. For that, the refractive-index anisotropy deltan2 and the product deltan2 of thickness d2 of the birefringence member 40, and d2 are very important, and set 0.8 micrometers as the range of 0.5 to 0.7 micrometers more preferably from

0.4 micrometers.
[0058] Furthermore, since this liquid crystal display component 62 uses the elliptically polarized light by the birefringence, when using an optically uniaxial transparence birefringent plate as the shaft and the birefringence member 40 of polarizing plates 15 and 16, the relation between that optical axis and the liquid crystal array directions 6 and 7 of the electrode substrates 11 and 12 of a liquid crystal cell 60 is very important for it.
[0059] Drawing 15 explains the operation effectiveness of the above-mentioned relation. Drawing 15 shows the relation of the liquid crystal molecule shaft array direction of the shaft of the polarizing plate at the time of seeing the liquid crystal display component of the configuration of drawing 16 from a top, the optical axis of an optically uniaxial transparence birefringence member, and the electrode substrate of a liquid crystal cell.
[0060] The liquid crystal molecule shaft array direction of the upper electrode substrate 11 with which the optical axis of the transparence birefringence member 40 optically uniaxial in 5 and 6 adjoin the birefringence member 40 and this in drawing 16 , The liquid crystal array direction of the bottom electrode substrate 12 and 8 7 The absorption shaft or polarization shaft of the upper polarizing plate 15, 9 is the absorption shaft or polarization shaft of the bottom polarizing plate 16. An include angle alpha The include angle of the liquid crystal array direction 6 of the upper electrode substrate 11, and the optical axis 5 of the optically uniaxial birefringence member 40 to make, An include angle beta is an include angle of the absorption shaft of the upper polarizing plate 15 or the polarization shaft 8, and the optical axis 5 of the optically uniaxial transparence birefringence member 40 to make, and an include angle gamma is an include angle of the absorption shaft of the bottom polarizing plate 16 or the polarization shaft 9, and the liquid crystal array direction 7 of the bottom electrode substrate 12 to make.

[0061] How to measure the angles alpha, beta, and gamma in this specification is defined here. In drawing 20 , it explains taking the case of the crossing angle of the optical axis 5 of the birefringence member 40, and the liquid crystal array direction 6 of an upper electrode substrate. Although the crossing angle of an optical axis 5 and the liquid crystal array direction 6 can be expressed with phi1 and phi2 as shown in drawing 20 , in this specification, the angle of the smaller one is adopted among phi1 and phi2. That is, since it is phi1<phi2 in drawing 20 (a), phi 1 is used as the crossing angle alpha of an optical axis 5 and the liquid crystal array direction 6, and since it is phi1>phi2 in drawing 20 (b), phi 2 is used as the crossing angle alpha of an optical axis 5 and the liquid crystal array direction 6. Of course, in the case of phi1=phi2, whichever may be taken.
[0062] In a liquid crystal display component, include angles alpha, beta, and gamma are very important.
[0063] As for an include angle alpha, it is more preferably desirable preferably from 50 degrees to set it as 60 degrees from 30 degrees from 20 degrees, and for an include angle beta to set an include angle gamma as 90 degrees from 0 times 70 degrees from 0 times 70 degrees preferably from 70 degrees, at 50 degrees, respectively 90 degrees.
[0064] In addition, if angle-of-torsion theta of the liquid crystal layer 50 of a liquid crystal cell 60 is within the limits of 180 to 360 degrees, even if the directions 10 of torsion are any of the direction of a clockwise rotation, and the direction of a counterclockwise rotation, the above-mentioned angles alpha, beta, and gamma should just be in above-mentioned within the limits.
[0065] In addition, in drawing 16 , although the birefringence member 40 is arranged between the upper polarizing plate 15 and the upper electrode substrate 11, you may arrange between the bottom electrode substrate 12 and the bottom polarizing plate 16 instead of this location. In this case, when the whole configuration of drawing 16 is made to do a handstand, it corresponds.
[0066] Drawing 17 is drawing showing examples, such as angle-of-torsion theta. As shown in drawing, angle-of-torsion theta of a liquid crystal molecule was 240 degrees, and as an optically uniaxial transparence birefringence member 40, parallel orientation (homogeneous orientation) of it was carried out, namely, it used the liquid crystal cell whose angle of torsion is 0 times. the ratio of the whorl pitch p (micrometer) of the liquid crystal ingredient with which thickness d (micrometer) of a liquid crystal layer and an optically active substance were added here -- d/p was set to 0.67. What formed by the

polyimide resin film and carried out rubbing processing of this was used for the orientation film 21 and 22. The tilt angle (pretilt angle) to which inclination orientation of the liquid crystal molecule with which the orientation film which performed this rubbing processing touches this is carried out to a substrate side is 4 times. deltan2 of the top Norikazu axial transparence birefringence member 40 and d2 are about 0.6 micrometers. On the other hand, the liquid crystal molecule of deltan1 of the liquid crystal layer 50 of distorted structure and d1 is about 0.8 micrometers 240 degrees.

[0067] At this time, when the electrical potential difference impressed to the liquid crystal layer 50 through the bottom electrodes 31 and 32 a top by making an include angle beta and making an include angle gamma into about 30 degrees about 30 degrees about 90 degrees in an include angle alpha was below a threshold and it became more than the threshold with light impermeability, i.e., black, and an electrical potential difference, monochrome display of light transmission, i.e., white, was realizable. Moreover, when the shaft of the bottom polarizing plate 16 was rotated 90 degrees from 50 degrees from the above-mentioned location, the applied voltage to the liquid crystal layer 50 was below a threshold and white and an electrical potential difference became more than the threshold, monochrome display contrary to the black above has been realized.

[0068] Drawing 18 shows the contrast change at the time of a time-sharing drive by 1/200 duty when changing an include angle alpha with the configuration of drawing 17 . That the include angle alpha indicated contrast very high at about 90 degrees to be falls as it shifts from this include angle. And if an include angle alpha becomes small, blueness will borrow the lighting section and the section non-switching on the light, if an include angle alpha becomes large, purple and the lighting section will become yellow and the section non-switching on the light will become impossible [ monochrome display ] anyway. Although a result with the same almost said of an include angle beta and an include angle gamma is brought, if it rotates about 90 degrees from 50 degrees as described above, in the case of an include angle gamma, it will become monochrome display of an inversion.

[0069] Drawing 19 is drawing showing other examples, such as angle-of-torsion theta. Basic structure is the same as the example shown in drawing 16 . However, it differs in that 260 degrees, deltan1, and d1 are about 0.65 micrometers - 0.75 micrometers as for angle of torsion of the liquid crystal molecule of the liquid crystal layer 50. deltan2 of the parallel orientation liquid crystal layer currently used as an optically uniaxial transparence birefringence member 40 and d2 are same about 0.58 micrometers as said example. The ratio with the whorl pitch p (micrometer) of the nematic liquid crystal ingredient with which the thickness d1 (micrometer) and the optically active substance of a liquid crystal layer were added was set to d/p=0.72.

[0070] At this time, the same monochrome display as the first example was realizable by making an include angle beta and making an include angle gamma into about 15 degrees for an include angle alpha about 35 degrees about 100 degrees. Moreover, the point in which monochrome display of an inversion is possible is the same as the first example almost by rotating the location of the shaft of a bottom polarizing plate 90 degrees from 50 degrees from the above-mentioned value. The inclination over a gap of include angles alpha, beta, and gamma is the same as the first example almost.

[0071] the above -- although the parallel orientation liquid crystal cell which does not have torsion of a liquid crystal molecule as an optically uniaxial transparence birefringence member 40 in which example was used, there is little color change according [ the direction where the liquid crystal molecule used the distorted liquid crystal layer about 60 degrees from 20 degrees rather ] to an include angle. This distorted liquid crystal layer is formed by pinching liquid crystal between the substrates the orientation processing direction of the transparence substrate of a pair with which orientation processing was performed was made to intersect predetermined angle of torsion like the above-mentioned liquid crystal layer 50. In this case, what is necessary is just to deal with the direction of 2 division-into-equal-parts angles of the angle of nip of the two orientation processing directions which sandwich the torsion structure of a liquid crystal molecule as an optical axis of a birefringence member. Moreover, a transparent high polymer film may be used as a birefringence member 40 (the thing of uniaxial stretching is desirable in this case). In this case, as a high polymer film, PET (polyethylene terephthalate), an acrylic resin film, and a polycarbonate are effective.

[0072] Although the birefringence member was still more nearly single in the above example, in addition to the birefringence member 40, in drawing 16 , the birefringence member of one more sheet can also be inserted between the bottom electrode substrate 12 and the bottom polarizing plate 16. In this case, what is necessary is just to readjust deltan2 of these birefringences member, and d2.
[0073] However, as shown in drawing 21 , a multicolor display is attained by preparing optical light-shielding film 33D on the upper electrode substrate 11 between red, green, the blue color filters 33R, 33G, and 33B, and each filter comrade. The relation between the array direction of the liquid crystal molecule in said example, the direction of torsion of a liquid crystal molecule, the shaft orientation of a polarizing plate, and the optical axis of a birefringence member is shown in drawing 18 .
[0074] In addition, in drawing 21 , on each filters 33R, 33G, and 33B and optical light-shielding film 33D, in order to mitigate the effect of such irregularity, the smooth layer 23 which consists of an insulating material was formed upwards, and the upper electrode 31 and the orientation film 21 are formed.
[0075] As explained above, according to the above-mentioned example, it has the outstanding time-sharing drive property, and the electric field effect mold liquid crystal display component which enables black and white and a multicolor display further can be realized.
[0076] Although this invention was concretely explained based on the example above, as for this invention, it is needless to say for it to be able to change variously in the range which is not limited to the above-mentioned example and does not deviate from the summary. For example, although the configuration of the outside of the condensing section 1, the configuration of a cavity 76, the quality of the material of the condensing section 1 or a light guide plate 37, the configuration of a light guide plate 37, the configuration of the lamp reflective covering 67, etc. were shown in the above-mentioned example, they are usable in others and various objects. For example, the configuration of the outside of the condensing section 1 may be formed so that the cross-section configurations of the center line of the fluorescence tubing 36 and a perpendicular direction may accomplish a Bezier curve. Moreover, in the above-mentioned example, although the reflective sheet was used as lamp reflective covering 67, after forming by vapor-depositing silver etc. to the inside after casting lamp reflective covering in a predetermined configuration using plastics etc., or establishing the reflector of a reflective sheet etc. monotonously, you may cast and manufacture in a predetermined configuration. Moreover, in the example of drawing 8 , although the cavity 76 was an air space, a cavity 76 may be filled up with gas, such as nitrogen. Furthermore, it cannot be overemphasized that can apply this invention to the liquid crystal display which has the back light which comes to contain a light guide plate, and it can apply also to the liquid crystal display of the active matrix which used the thin film transistor etc. also for the liquid crystal display of a passive matrix as a switching element.
[0077]
[Effect of the Invention] As explained above, according to this invention, efficiency for light utilization can be improved by controlling the direction of the beam of light by which forms the medium of the solid-state which follows a light guide plate in the perimeter of fluorescence tubing, and outgoing radiation is carried out from fluorescence tubing. Therefore, the brightness of a back light improves, the display screen becomes bright and display quality improves. Moreover, since a solid-state medium is formed in the perimeter of fluorescence tubing, the insulation around fluorescence tubing can be made high, the leakage current of fluorescence tubing can be decreased, and power consumption can be reduced. Moreover, since the perimeter of fluorescence tubing is covered by the solid-state medium, the configuration of lamp reflective covering can be formed and held good, and efficiency for light utilization can be improved.

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[Translation done.]

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CLAIMS

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[Claim(s)]
[Claim 1] The liquid crystal display characterized by having been arranged under a liquid crystal display component, having carried out the light guide of the light of fluorescence tubing, and having prepared the condensing section which changes from a solid medium to the perimeter of said fluorescence tubing in the liquid crystal display which has the back light which grows into said liquid crystal display component including the light guide plate which supplies light, and preparing said light guide plate succeeding said condensing section.
[Claim 2] The liquid crystal display which is arranged under a liquid crystal display component, carries out the light guide of the light of fluorescence tubing, prepares the condensing section which consists of a transparent material in the perimeter except the both ends of said fluorescence tubing in the liquid crystal display which has the back light which grows into said liquid crystal display component including the light guide plate which supplies light, and prepares said light guide plate succeeding said condensing section, and is characterized by the end surface for entering light of said light guide plate and the major axis of said fluorescent lamp being almost parallel.
[Claim 3] In the liquid crystal display which has the back light which is arranged under a liquid crystal display component, carries out the light guide of the light of fluorescence tubing, and grows into said liquid crystal display component including the light guide plate which supplies light Prepare the condensing section which consists of a transparent material in the perimeter except the both ends of said fluorescence tubing, and said light guide plate is prepared in one succeeding said condensing section. The liquid crystal display characterized by adjusting so that the end surface for entering light of said light guide plate and the major axis of said fluorescent lamp may be almost parallel and the light guide of the light of said fluorescence tubing may be carried out for the refractive index of each part of said condensing section to the direction of said transparent material.
[Claim 4] The liquid crystal display according to claim 1, 2, or 3 characterized by fitting in and forming said fluorescence tubing in the long and slender through hole prepared in said condensing section.
[Claim 5] The liquid crystal display according to claim 1, 2, or 3 characterized by forming the cavity of the configuration formed so that the direction where the light of said fluorescence tubing progresses between said condensing sections and said fluorescence tubing might be controlled.
[Claim 6] The liquid crystal display according to claim 1 or 2 characterized by adjusting the refractive index of each part of said condensing section so that the light guide of the light of said fluorescence tubing may be carried out to the direction of said transparent material.
[Claim 7] The liquid crystal display according to claim 3 or 7 characterized by adjusting gradually the refractive index of each part of said condensing section greatly as said light guide plate was approached so that the light guide of the light of said fluorescence tubing might be carried out to the direction of said transparent material.
[Claim 8] The liquid crystal display according to claim 1, 2, or 3 characterized by having covered without the crevice lamp reflective covering which established the reflector in the inside on the outside of said condensing section, and preparing it in it.

[Claim 9] The liquid crystal display according to claim 1, 2, or 3 characterized by having the holder which has the crevice which fits into said both ends of said fluorescence tubing, and establishing a reflector in the field of said fluorescence tubeside of said holder.

[Claim 10] The liquid crystal display according to claim 1, 2, or 3 characterized by having the holder which has the crevice which fits into said both ends of said fluorescence tubing, and preparing a reflector for the field of said fluorescence tubeside of said holder, and the outside of said condensing section between wrap lamp reflective coverings.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the back light of the liquid crystal display of one example of this invention.
[Drawing 2] In the back light of the liquid crystal display of one example of this invention, it is drawing showing signs that the light which carried out outgoing radiation from fluorescence tubing is carrying out the light guide, with the location dependency of the refractive index of the condensing section.
[Drawing 3] In the back light of the liquid crystal display of one example of this invention, it is drawing showing the relation between a distance radial [ from the core of fluorescence tubing ], and the refractive index of the condensing section (medium) of the fluorescence tubing circumference.
[Drawing 4] In the back light of the liquid crystal display of one example of this invention, it is drawing showing the relation between the distance from the end face of the condensing section (medium), and the refractive index of said condensing section of the fluorescence tubing circumference.
[Drawing 5] It is the important section sectional view showing the concrete example to which the solid-state medium of the same refractive index changed the refractive index of the condensing section stair-like in piles in the shape of a layer.
[Drawing 6] It is the important section sectional view showing the concrete example to which the solid-state medium of the same refractive index changed the refractive index of the condensing section stair-like in piles in the shape of a layer.
[Drawing 7] It is the important section sectional view showing the concrete example to which the solid-state medium of the same refractive index changed the refractive index of the condensing section stair-like in piles in the shape of a layer.
[Drawing 8] In the back light of the liquid crystal display of one example of this invention, it is the important section sectional view showing signs that the light which carried out outgoing radiation from fluorescence tubing is carrying out the light guide, by the cavity around fluorescence tubing.
[Drawing 9] It is the important section sectional view showing that it can set to the back light of the liquid crystal display of one example of this invention, and the configuration can be easily formed and held also in the configuration of complicated lamp reflective covering.
[Drawing 10] It is the perspective view of the back light of the liquid crystal display of one example of this invention.
[Drawing 11] It is the perspective view of the back light of the liquid crystal display of one example of this invention.
[Drawing 12] It is the decomposition perspective view of an example of the liquid crystal display module of the passive matrix which can apply this invention.
[Drawing 13] It is the block flow diagram of an example of a laptop computer.
[Drawing 14] It is the perspective view of an example of a laptop computer.
[Drawing 15] It is the explanatory view having shown an example of the relation between the array direction of the liquid crystal molecule in the liquid crystal display component of the passive matrix which can apply this invention, the direction of torsion of a liquid crystal molecule, the shaft orientation

of a polarizing plate, and the optical axis of a birefringence member.
[Drawing 16] It is the important section decomposition perspective view of an example of a liquid crystal display component.
[Drawing 17] It is the explanatory view having shown the relation between the direction of torsion of the liquid crystal molecule in the liquid crystal display component of another example, the shaft orientation of a polarizing plate, and the optical axis of a birefringence member.
[Drawing 18] It is the graph which shows the contrast about the example of drawing 15 of a liquid crystal display component, and a transmitted light color-crossing angle alpha property.
[Drawing 19] It is the explanatory view having shown the relation between the array direction of the liquid crystal molecule in the liquid crystal display component of still more nearly another example, the direction of torsion of a liquid crystal molecule, the shaft orientation of a polarizing plate, and the optical axis of a birefringence member.
[Drawing 20] It is drawing for explaining how measuring the crossing angles alpha, beta, and gamma.
[Drawing 21] a part of example of the upper electrode substrate section of a liquid crystal display component -- it is a notching perspective view.
[Description of Notations]
1 [ -- A diffusion sheet, 66 / -- A reflective sheet, 67 / -- Lamp reflective covering, 76 / -- A cavity, 77 / -- A rubber bush, 78 / -- A reflector, 79 / -- Reflector. ] -- The condensing section, 36 -- Fluorescence tubing, 37 -- A light guide plate, 65

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[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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## DRAWINGS

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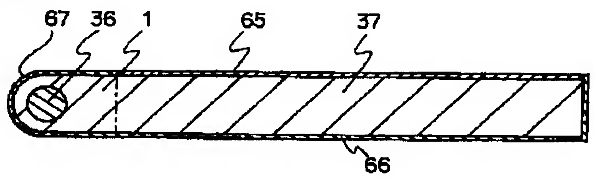
[Drawing 1]

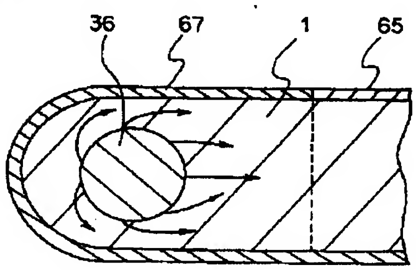
図1




1…集光部
36…蛍光管
37…導光板
65…拡散シート
66…反射シート
67…ランプ反射カバー

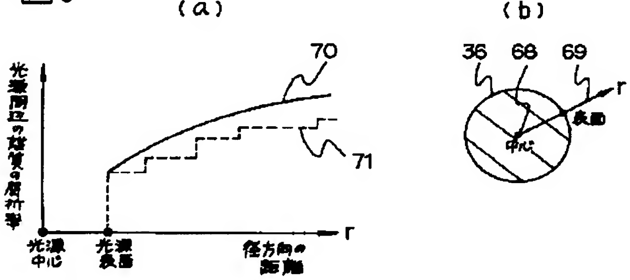
[Drawing 2]

図2

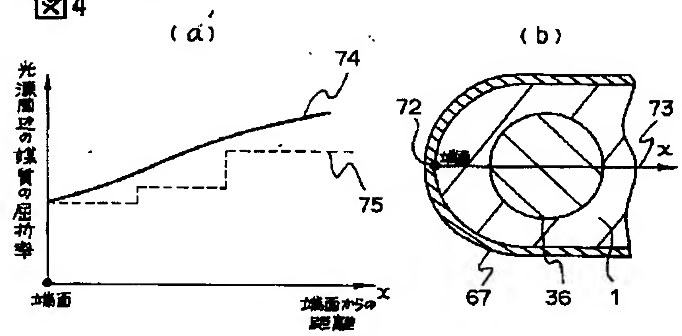



[Drawing 3]

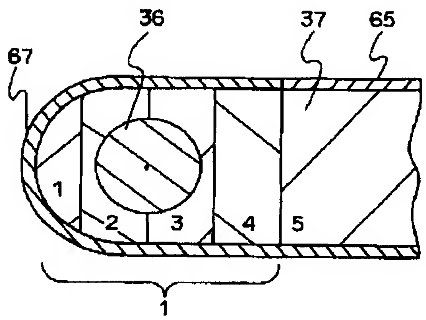
図3



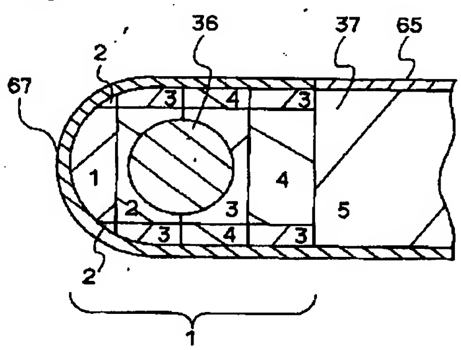
[Drawing 4]
図4



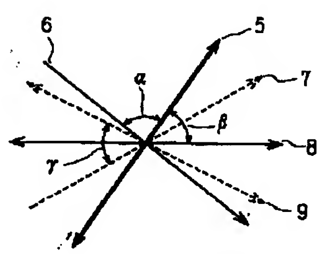

[Drawing 5]
図5



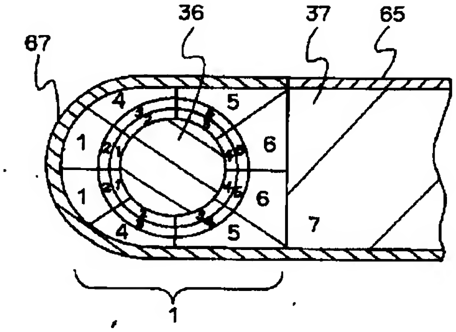

[Drawing 6]
図6



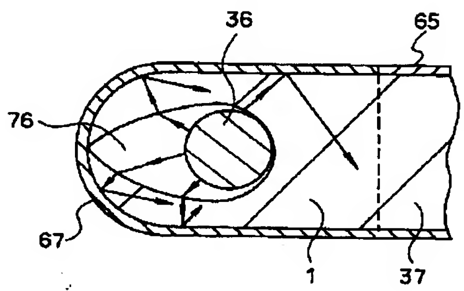

[Drawing 15]
図１５



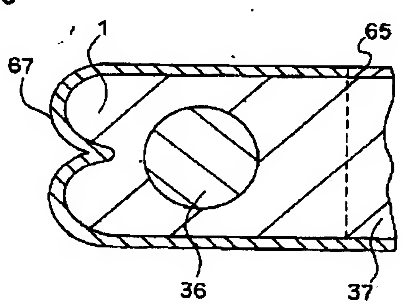
[Drawing 7]
図7



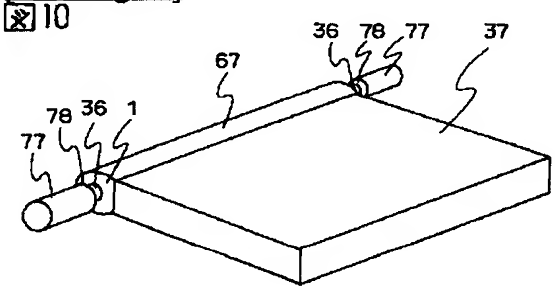

[Drawing 8]
図8




[Drawing 9]
図9

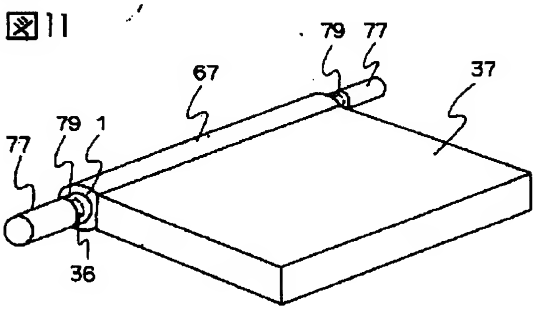



[Drawing 10]
図10



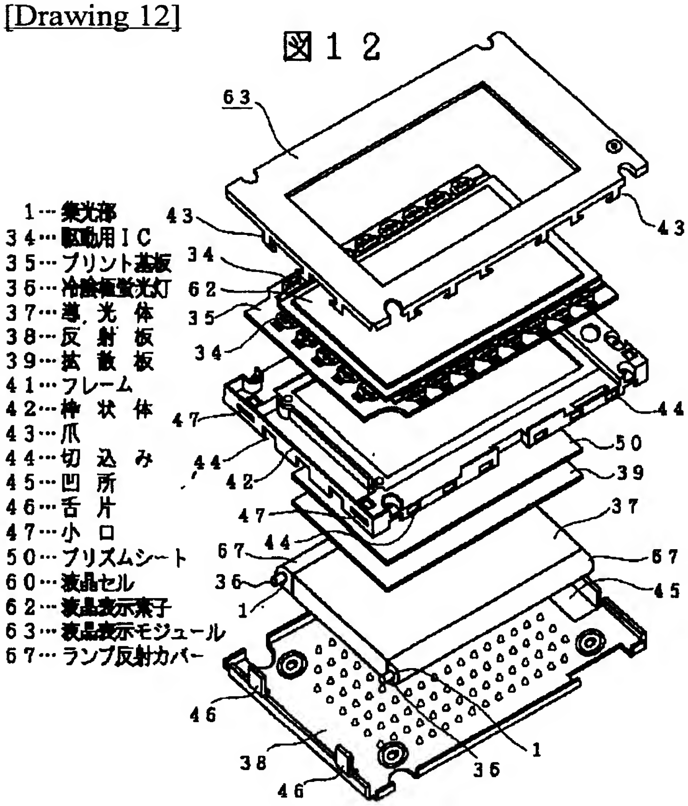
[Drawing 11]

図11



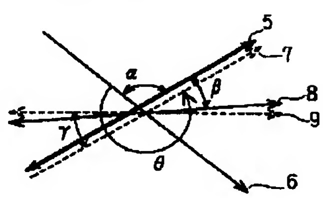

[Drawing 12]

図１２



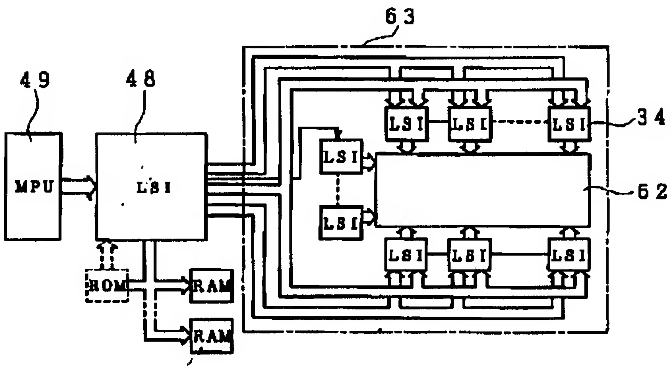

[Drawing 19]

図１９




[Drawing 13]

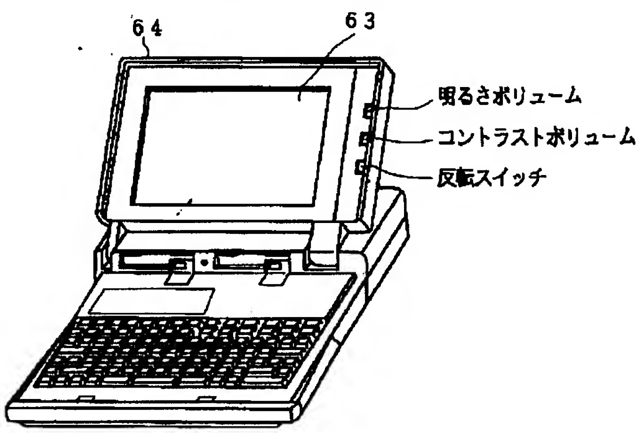
図１３




３４…駆動用ＩＣ
４８…コントロール用ＬＳＩ
４９…マイクロプロセッサユニット
６２…液晶表示素子
６３…液晶表示モジュール
６４…ラップトップパソコン

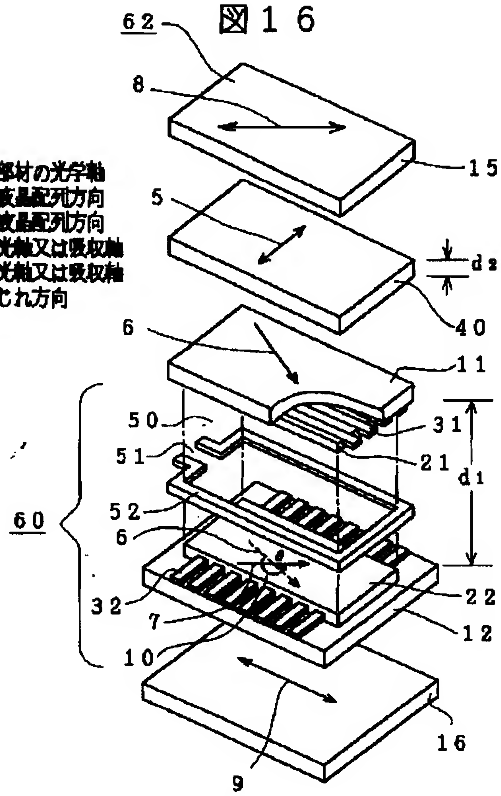
[Drawing 14]

図１４




[Drawing 16]

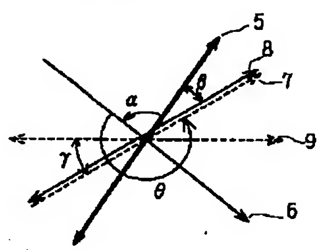
図１６




5…一軸性複屈折部材の光学軸
6…上電極基板の液晶配列方向
7…下電極基板の液晶配列方向
8…上偏光板の偏光軸又は吸収軸
9…下偏光板の偏光軸又は吸収軸
10…液晶分子のねじれ方向
11…上電極基板
12…下電極基板
15…上偏光板
16…下偏光板
21…配向膜
22…配向膜
31…上電極
32…下電極
40…複屈折部材
50…液晶層
51…液晶封入口
52…シール材
60…液晶セル
62…液晶表示素子

[Drawing 17]

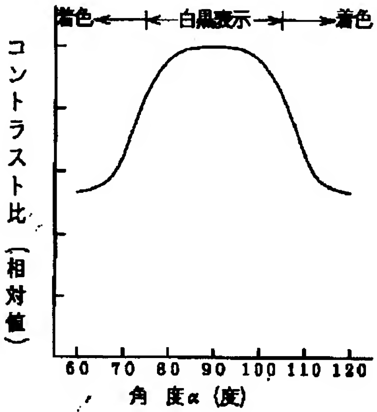
図１７




5…一軸性複屈折部材の光学軸
6…上電極基板の液晶配列方向
7…下電極基板の液晶配列方向
8…上偏光板の偏光軸又は吸収軸
9…下偏光板の偏光軸又は吸収軸

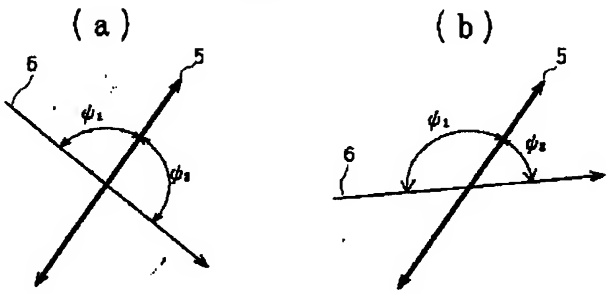
[Drawing 18]

図１８



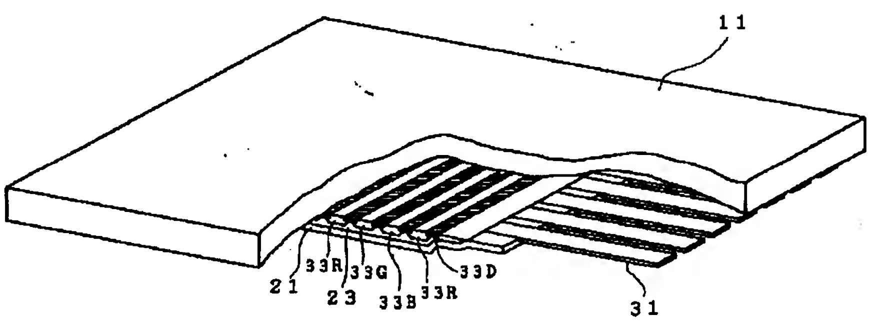

[Drawing 20]

図２０




[Drawing 21]

図２１




１１…上電極基板
２１…配向膜
２３…平滑層
３３D…光遮光膜
３３R…赤フィルタ
３３G…緑フィルタ
３３B…青フィルタ

[Translation done.]

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| Ｇ０２Ｆ | 1/1335 | ５３０ | | | |
| Ｆ２１Ｖ | 8/00 | Ｄ | | | |

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(71)出願人　000005108
株式会社日立製作所
東京都千代田区神田駿河台四丁目６番地

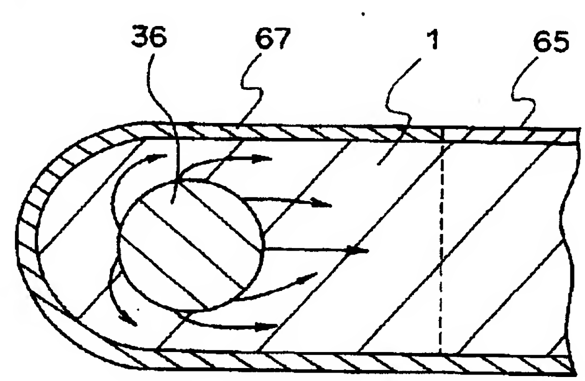
(72)発明者　木村　肇
千葉県茂原市早野3300番地　株式会社日立製作所電子デバイス事業部内

(74)代理人　弁理士　中村　純之助

(54)【発明の名称】　液晶表示装置

(57)【要約】
【構成】蛍光管（３６）の周囲に導光体から成る集光部（１）を設け、集光部（１）に連続して導光板（３７）を設け、集光部（１）の各部の屈折率が蛍光管（３６）の光を導光体（３７）の方に導光するように調整され、かつ、集光部（１）の外側にランプ反射カバー（６７）をすき間なく覆った構成。
【効果】蛍光管の周囲に導光板と連続する固体の媒質を設けることにより、光利用効率を向上できるので、バックライトの輝度が向上し、表示品質が向上する。また、蛍光管の周囲の絶縁性を高めることができ、蛍光管の漏れ電流を減少でき、消費電力を低減できる。また、ランプ反射カバーの形状を良好に形成、保持することができ、光利用効率を向上できる。

図2



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【特許請求の範囲】

【請求項１】液晶表示素子の下に配置され、蛍光管の光を導光し、前記液晶表示素子に光を供給する導光板を含んで成るバックライトを有する液晶表示装置において、前記蛍光管の周囲に固体の媒質から成る集光部を設け、かつ、前記集光部に連続して前記導光板を設けたことを特徴とする液晶表示装置。

【請求項２】液晶表示素子の下に配置され、蛍光管の光を導光し、前記液晶表示素子に光を供給する導光板を含んで成るバックライトを有する液晶表示装置において、前記蛍光管の両端を除く周囲に導光体から成る集光部を設け、前記集光部に連続して前記導光板を設け、かつ、前記導光板の入光端面と前記蛍光灯の長軸とがほぼ平行であることを特徴とする液晶表示装置。

【請求項３】液晶表示素子の下に配置され、蛍光管の光を導光し、前記液晶表示素子に光を供給する導光板を含んで成るバックライトを有する液晶表示装置において、前記蛍光管の両端を除く周囲に導光体から成る集光部を設け、前記集光部に連続して前記導光板を一体的に設け、前記導光板の入光端面と前記蛍光灯の長軸とがほぼ平行であり、かつ、前記集光部の各部の屈折率を、前記蛍光管の光を前記導光体の方に導光するように調整したことを特徴とする液晶表示装置。

【請求項４】前記蛍光管を前記集光部に設けた細長い貫通穴に嵌合して設けたことを特徴とする請求項１、２または３記載の液晶表示装置。

【請求項５】前記集光部と前記蛍光管との間に、前記蛍光管の光の進む方向を制御するように形成された形状の空洞を形成したことを特徴とする請求項１、２または３記載の液晶表示装置。

【請求項６】前記集光部の各部の屈折率を、前記蛍光管の光を前記導光体の方に導光するように調整したことを特徴とする請求項１または２記載の液晶表示装置。

【請求項７】前記集光部の各部の屈折率を、前記蛍光管の光を前記導光体の方に導光するように前記導光板に近づくにつれて徐々に大きく調整したことを特徴とする請求項３または７記載の液晶表示装置。

【請求項８】前記集光部の外側に、内面に反射面を設けたランプ反射カバーをすき間なく覆って設けたことを特徴とする請求項１、２または３記載の液晶表示装置。

【請求項９】前記蛍光管の前記両端に嵌合する凹部を有する保持具を有し、前記保持具の前記蛍光管側の面に反射面を設けたことを特徴とする請求項１、２または３記載の液晶表示装置。

【請求項１０】前記蛍光管の前記両端に嵌合する凹部を有する保持具を有し、前記保持具の前記蛍光管側の面と、前記集光部の外側を覆うランプ反射カバーとの間に反射体を設けたことを特徴とする請求項１、２または３記載の液晶表示装置。

【発明の詳細な説明】

2

【０００１】

【産業上の利用分野】本発明は、液晶表示素子の下に配置され、光源である蛍光管の光を導光し、液晶表示素子に光を供給する導光板を含んで成るバックライトを有する液晶表示装置に関する。

【０００２】

【従来の技術】液晶表示装置は、例えば、透明導電膜から成る画素電極と配向膜等を積層した面がそれぞれ対向するように所定の間隔を隔てて２枚の透明ガラス基板を重ね合わせ、両基板間の縁周囲に設けたシール剤により、両基板を貼り合わせると共に両基板間に液晶を封止し、さらに両基板の外側に偏光板を設けて成る液晶表示素子（液晶表示パネル）と、液晶表示素子の下に配置され、液晶表示素子に光を供給するバックライトと、液晶表示素子を駆動する回路基板等を含んで構成される。

【０００３】バックライトは、例えば、光源から発せられる光を光源から離れた方へ導き、液晶表示素子全体に光を均一に照射するための透明のアクリル等の合成樹脂板から成るほぼ直方体状の導光板と、導光板の側面近傍に該側面に沿って該側面と平行に配置した光源である蛍光管と、蛍光管をそのほぼ全長にわたって覆い、断面形状がほぼU字状で、蛍光管の光を外部に漏らさないように導光板へもどすランプ反射カバーと、導光板の上に配置され、導光板からの光を拡散する拡散シートと、導光板の下に配置され、導光板からの光を液晶表示素子の方へ反射させる反射シートとから構成される。また、蛍光管から導光板内に入射した光は、導光板内を全反射しながら導光するが、拡散反射により導光板の上面から出射させるために、導光板の底面には複数個の光拡散用の印刷による白いインクドットパタン、あるいは該底面と一体の穴、溝、凸部が、光が均一に照射できるように形成されている。例えばインクドットの場合は、光源から離れるにしたがってインクドットの面積が大きくなるように印刷してある。これにより、光源から近い場所でも遠い場所でも均一な光が照射される。また、液晶表示素子の下に拡散板を介してそれぞれ平行に配列された複数本の蛍光管と、蛍光管の下に配置され、蛍光管からの光を液晶表示素子の方へ反射させる反射板とから構成される、いわゆる直下型のバックライトもある。

【０００４】このような従来の液晶表示装置は、例えば特公昭６０－１９４７４号公報や実開平４－２２７８０号公報に記載されている。

【０００５】

【発明が解決しようとする課題】従来のバックライトでは、蛍光管と、導光板およびランプ反射カバーとの間には空間が存在する。光が異なる媒質間を進むとき、そこで光の反射、屈折が起こる。光源である蛍光管から出射した光がランプ反射カバーで反射して、蛍光管と導光板との間に存在する空気層から導光板に入るとき、光は屈折して入光するとともに、その導光板の端面（入光面）

で光が反射する。その反射光は再び蛍光管の方へもどって吸収されてしまう。そのため、光利用効率が減少する。

【０００６】また、蛍光管から出射し、ランプ反射カバーで反射した光線の進む方向をうまく制御することができないため、ランプ反射カバーで反射した光は再び蛍光管の方へもどり、吸収されてしまう。そのため、光利用効率が減少する。

【０００７】また、蛍光管から出射した光が、蛍光管と導光板との間の空気層から導光板の入光端面に入るとき、光は光学的に「疎」から「密」へ進むため、屈折光の屈折角が小さくなる。この結果、導光板に入射した光はインクドットパタンが印刷された下面と平行に、すなわち、水平方向に進む光が多くなる。したがって、導光板の入光端面と対向する端面に達する光が多くなる。この端面の外側には反射シートが設けてあるので、この端面に達した光はこの端面で反射し、再び入光端面に達し、導光板を出て、蛍光管に吸収される。そのため、光利用効率が減少する。

【０００８】また、ランプ反射カバー、蛍光管、および両者の間の空気層によりコンデンサーが構成され、蛍光管を流れる電流が漏れやすく、そのため、消費電力が大きくなる。

【０００９】また、蛍光管の光を導光板の方へもどす従来のランプ反射カバーは、内面に反射面を設けた反射シートにより構成されている。すなわち、取り付ける前は長方形状のシートで、その両端部を導光板の上面および下面の端部に固定する。したがって、蛍光管と反射シートとの間は空間であるので、蛍光管の周囲に巻き付ける反射シートの形状を制御し、保持するのが難しかった。

【００１０】さらに、蛍光管はその両端がゴムブッシュの穴にはめられて保持される。したがって、蛍光管からゴムブッシュの方へ出射される光はゴムッシュにより吸収される。また、ランプ反射カバーとゴムブッシュとの間にはすき間があるので、そこから光が漏れる。そのため、光利用効率が減少する。

【００１１】本発明の第１の目的は、蛍光管の光が導光板に入射する光の量、および導光板の上面から出射する光の量を増大させて、光の利用効率を向上することができる液晶表示装置を提供することにある。

【００１２】本発明の第２の目的は、蛍光管に流れる電流が外部に漏れる量を減少させて、消費電力を低減することができる液晶表示装置を提供することにある。

【００１３】本発明の第３の目的は、ランプ反射カバーの形状を正確に形作り、保持することができ、かつ蛍光管から出射した光およびランプ反射カバーで反射した光の進行方向の制御性を向上することができる液晶表示装置を提供することにある。

【００１４】本発明の第４の目的は、蛍光管を保持するゴムブッシュ等の保持具の蛍光管側の面で光が吸収されるのを防止し、また、ランプ反射カバーと保持具との間のすき間から光が漏れるのを防止して、光利用効率を向上することができる液晶表示装置を提供することにある。



【００１５】

【課題を解決するための手段】上記の課題を解決するために、本発明は、光源である蛍光管の周囲が固体の媒質、すなわち、導光体で覆われた構造を提供する。また、蛍光管を覆う導光体から成る集光部の媒質の屈折率が位置依存性を持っている構造を提供する。また、導光体から成る集光部と蛍光管との間に所定の形状の空洞を設け、この空洞の形状によって蛍光管から出射される光の進む方向を制御する構造を提供する。また、蛍光管の周囲を固体の媒質で覆うことにより、形状が正確に形作られたランプ反射カバーを蛍光管の周囲に設けた構造を提供する。さらに、蛍光管を保持する保持具の蛍光管側の面に反射面を設けるか、あるいは保持具とランプ反射カバーとの間に反射体を設けた構造が提供される。

【００１６】すなわち、本発明は、液晶表示素子の下に配置され、蛍光管の光を導光し、前記液晶表示素子に光を供給する導光板を含んで成るバックライトを有する液晶表示装置において、前記蛍光管の周囲に固体の媒質から成る集光部を設け、かつ、前記集光部に連続して前記導光板を設けたことを特徴とする。

【００１７】また、前記導光板の入光端面と前記蛍光灯の長軸とがほぼ平行であることを特徴とする。

【００１８】また、前記蛍光管の両端を除く周囲に導光体から成る集光部を設けたことを特徴とする。

【００１９】また、前記蛍光管を前記集光部に設けた細長い貫通穴に嵌合して設けたことを特徴とする。

【００２０】また、前記集光部と前記蛍光管との間に、前記蛍光管の光の進む方向を制御するように形成された形状の空洞を形成したことを特徴とする。

【００２１】また、前記集光部の各部の屈折率を、前記蛍光管の光を前記導光体の方に導光するように調整したことを特徴とする。

【００２２】また、前記集光部の各部の屈折率を、前記蛍光管の光を前記導光体の方に導光するように前記導光板に近づくにつれて徐々に大きく調整したことを特徴とする。

【００２３】また、前記集光部の外側に、内面に反射面を設けたランプ反射カバーをすき間なく覆って設けたことを特徴とする。

【００２４】また、前記蛍光管の前記両端に嵌合する凹部を有する保持具を有し、前記保持具の前記蛍光管側の面に反射面を設けたことを特徴とする。

【００２５】さらに、前記蛍光管の前記両端に嵌合する凹部を有する保持具を有し、前記保持具の前記蛍光管側の面と、前記集光部の外側を覆うランプ反射カバーとの間に反射体を設けたことを特徴とする。

【0026】

【作用】本発明では、光源である蛍光管から出射した光は、蛍光管に再びもどってくると、蛍光管でいくらかが吸収されてしまう。そこでの損失分をなるべく減らしたい。蛍光管にもどってくるのは、ランプ反射カバーで反射してもどってくるものと、導光板の入射端面で反射してもどってくるものとがある。導光板の入射端面での反射は、空気層と導光板との屈折率の違いに起因する。そこで、本発明では、蛍光管を固体の媒質、すなわち導光体で覆ってしまう（この部分を集光部と称す）。すなわち、従来では、空気層と導光板との屈折率の差により、反射成分があったが、蛍光管を導光体で覆い、かつ、この集光部と導光板とを一体化することにより、蛍光管の周囲の集光部と導光板との間の空気層をなくすことができるため、屈折率の差が生じず、光が蛍光管にもどり、蛍光管に吸収される量が減少する。

【0027】また、光は屈折率の大きい方へ進むので、蛍光管を覆う集光部の媒質の屈折率に位置依存性を持たせて、場所によって屈折率を変えて、導光板に向かうにつれて徐々に大きくし、光を導きたい方向に向け、光を効率よく導光板へ導くことができる。屈折率に位置依存性を持たせるには、集光部の屈折率を徐々に変化させてもよいし、何層かを階段状に変化させてもよい。

【0028】また、蛍光管とそれを覆う媒質との間に、例えば空気が存在する空洞を設け、その空洞の形状によって光線の方向を制御することができる。これは、空気よりも固体の媒質の方が屈折率が大きいので、光は屈折率の大きい方へ進むのを利用し、蛍光管の周囲の導光体の屈折率に位置依存性を持たせることと同じである。

【0029】また、上述のように、光は光学的には「疎」から「密」に進むため、従来では、空気層から導光板の端面に入射した光は、屈折光の屈折角が小さくなるので、そこで、ある限られた屈折角を持つ光になり、光が水平方向に向きやすくなり、それによって屈折入射光は該入射端面と反対の端面で反射して、蛍光管にもどってきて吸収される量が多かった。しかし、本発明では、空気層と導光板の入射端面との境界がないため、この吸収される量を減少させることができる。

【0030】また、本発明による蛍光管を覆う固体の媒質は、従来の蛍光管とランプ反射カバーとの間の空気層より絶縁性が高いので、蛍光管とランプ反射カバーと空気層でコンデンサーが構成されることにより、蛍光管を流れる電流が漏れてしまう量を少なくすることができ、消費電力を低減することができる。

【0031】また、固体の媒質により蛍光管を覆うため、この固体媒質から成る集光部の外形を所定の形状に形作ることにより、蛍光管の周囲を囲うランプ反射カバーの形状を容易に決めて固定することができる。したがって、ランプ反射カバーを複雑な形状に形成することも容易である。

【0032】さらに、蛍光管を保持するゴムブッシュの蛍光管側の面に反射面を設けるか、あるいは、ゴムブッシュとランプ反射カバーとの間に反射体を設けることにより、ゴムブッシュにより光が吸収されるのを防止し、ランプ反射カバーとゴムブッシュとの間のすき間から光が漏れるのを抑制でき、光利用効率を向上することができる。

【0033】

【実施例】図1は、本発明の一実施例の液晶表示装置のバックライトを示す断面図である。37は導光板、36は蛍光管、65は導光板37の上面に配置された拡散シート、66は導光板37の下面に配置された反射シート、67はランプ反射カバーである。ランプ反射カバー67と反射シート66とは共通の1枚のシートで構成されている。また、ここで図示しない導光板37の2側面にも反射シートが設けられている。1は蛍光管36の周囲に導光板37と一体に形成された集光部である。なお、ここでは導光板37の下面に印刷により設けたインクドットパタン（これに限らない。下面と一体に形成された穴、溝、凸部等の場合も含む。以下、同様）は図示省略してある。すなわち、蛍光管36の周囲に例えばアクリル等の導光体から成る集光部1をすき間なく設け、集光部1と導光板37とは一体に形成されている。集光部1には導光板37の入光端面と平行に細長い貫通穴が設けられ、この中に蛍光管36が挿入、保持されている。また、ランプ反射カバー67は、蛍光管36の周囲の導光体から成る所定の外形に形成された集光部1の外側にすき間なく覆われ、例えば接着材により固定されている。また、集光部1あるいは導光板37と、ランプ反射カバー67とにそれぞれ対応する凸部と凹部を形成し、合わせてはめ込んで固定してもよい。さらに、集光部1あるいは導光板37の表面に、例えば銀やアルミニウム等を真空蒸着することにより、反射面を形成し、ランプ反射カバー67自体を構成してもよい。

【0034】光源である蛍光管36から出射した光は、直接、あるいはランプ反射カバー67により反射した後、導光板37に入射する。導光板37に入射し、その上面に達した光のうち、全反射しないものはそこから拡散シート65を通って出射し、導光板37の上に配置される図示しない液晶表示素子（図12の液晶表示素子62の実際に外から見える液晶表示部分、すなわち、可視領域）に光を供給する。また、導光板37の下面に印刷されたインクドットパタンに当たった光は、そこで拡散反射して上面に達し、拡散シート65を通って出射する。従来は、導光板の入射端面から入射した光は、インクドットパタンに当たらない限り、空気層と導光板との媒質の違いによる屈折率の差により全反射して導光板37の上面から出射することはなかったが、本実施例では全反射しない光もあるため、導光板37の上面の反射面、すなわち、ランプ反射カバー67を表示部の可視領

域にまで広げ、かつ、蛍光管３６の近傍の導光板３７の下面に印刷するインクドットパタンの密度を小さくしてある。

【００３５】しかし、この場合でも、蛍光管３６から出射してランプ反射カバー６７で反射して、再び蛍光管３６にもどってきて吸収される光がある。そこで、図２（矢印は蛍光管３６から出射する光を示す）に示すように、蛍光管３６の周囲の導光体から成る集光部１の屈折率を調整して光の方向を制御する。すなわち、光は屈折率の大きい方へ進むので、集光部１の屈折率を徐々に変化させることにより（具体的な構成は図５、６、７を用いて後で説明する）、光線の方向を導光板３７の方へ向かうように制御して、蛍光管３６の光がランプ反射カバー６７で反射して蛍光管３６に再びもどってくる光を減少させるようにする。

【００３６】蛍光管３６の周囲の固体の媒質の屈折率を変化させるには、以下のようにする。図３（ａ）、（ｂ）は、蛍光管３６の中心６８からの半径方向ｒの距離と、蛍光管３６の周囲の媒質（図１の集光部１）の屈折率との関係を示す図である。すなわち、蛍光管３６の中心６８をグラフの原点にとり、そこから半径方向ｒに座標６９をとる。実線７０は、蛍光管３６から離れるにしたがって徐々に屈折率を大きくしている例を示す。屈折率をこのように徐々に大きくする理由は、光は屈折率の大きい方に進むので、蛍光管３６の表面から外部に向けて屈折率を徐々に大きくすることによって、蛍光管３６から光は出射しやすいが、屈折率が大きい方から小さい方へは、すなわち、蛍光管３６へもどる方向へは光は進みにくい。したがって、蛍光管３６から出射してランプ反射カバー６７の内面で反射して蛍光管３６に再びもどってくる光の量を減少することができる。なお、蛍光管３６の周囲の固体の媒質の屈折率を、実線７０に示すように徐々に大きくするのが製造上難しい場合は、破線７１に示すように、同一の屈折率の固体の媒質を層状に重ねることにより、屈折率を階段状に変化させてもよい。

【００３７】図４（ａ）、（ｂ）は、導光板３７の端面７２からの水平方向ｘの距離と、蛍光管３６の周囲の媒質（集光部１）の屈折率との関係を示す図である。導光板３７の端面７２をグラフの原点にとり、そこから水平方向ｘに座標７３をとる。実線７４は、蛍光管３６から離れるにしたがって徐々に屈折率を大きくしている例を示す。屈折率をこのように徐々に大きくする理由は、光は屈折率の大きい方に進むので、蛍光管３６の表面から表示部である導光板３７の方へ向けて屈折率を徐々に大きくすることによって、拡散シート６５（図１参照）の上面から出射する光の量を増加でき、また、ランプ反射カバー６７で反射して、あるいは導光板３７の入射端面と反対の端面で反射して、蛍光管３６に再びもどってくる光の量を減少することができる。なお、蛍光管３６の周囲の固体の媒質の屈折率を、実線７４に示すように徐々に大きくするのが製造上難しい場合は、破線７５に示すように、同一の屈折率の固体の媒質を層状に重ねることにより、屈折率を階段状に変化させてもよい。

【００３８】ただし、図３、図４はどちらも１次元での話であり、実際は図３と図４とを組み合わせて、双方を満足するように２次元的に集光部１の屈折率を変化させることにより、図２に示すように光線が進むように制御する。

【００３９】同一の屈折率の固体の媒質を層状に重ねて、集光部１の屈折率を階段状に変化させた具体的な例を図５、図６、図７の断面図に示す。図５、図６の集光部１および導光板３７における１～５の数字、および図７の１～７の数字は、各部の屈折率を示し、数字が大きいほど、屈折率が大きいことを示す。なお、図５～７はあくまで例示であり、層数や形状、構成はこの他種々考えられる。

【００４０】さらに、蛍光管３６の周囲の媒質の屈折率を変化させるという意味では、空気も媒質の１つである。そこで、図８に示すように、蛍光管３６の周囲、すなわち、蛍光管３６と集光部１との間に空洞７６を設けて、所定の形状の空洞７６内の空気層と集光部１との屈折率の違いを利用して光線の進む方法を制御してもよい。すなわち、蛍光管３６の周囲の気体の媒質である空洞７６内の空気層の形状と、固体の媒質とで構成される集光部１で光線の進む方向を制御する。蛍光管３６から出射される光は、屈折率の大きい方へ進むので、空気層の存在により蛍光管３６の方へもどってきにくい。この例も、図２～図７と同様の作用、効果を奏する。すなわち、蛍光管３６から出射してランプ反射カバー６７で反射して蛍光管３６に再びもどってくる光の量を減少することができる。なお、図８の集光部１の固体の媒質の屈折率も徐々にあるいは段階的に制御してもよい。

【００４１】なお、導光板３７の材質は例えばアクリル等を用いることができ、また、集光部１の固体の媒質も同様に例えばアクリル等を用いることができる。導光板３７と集光部１とを一体化するには、両者を別々に形成した後、接着材等を用いて接着してもよいし、あるいは最初から一体のものとして射出成型等により形成してもよい。

【００４２】また、集光部１の外側の形状、およびその外側に設けるランプ反射カバー６７の形状は図１～図８に示した形状に限定されない。例えば図９に示すような複雑な形状に形成することもできる。

【００４３】また、従来のランプ反射カバーは、上述のように取り付ける前は、内面に反射面を設けた長方形状の反射シートで、その両端部を導光板の上面および下面の端部に固定する。したがって、蛍光管と反射シートとの間は空間であるので、蛍光管の周囲に巻き付ける反射シートの形状を制御、保持するのが難しかった。しか

し、上記図１～図９に示した構成では、蛍光管３６の周囲は固体の媒質からなる集光部１により取り囲まれているので、集光部１の外側に反射シート等からランプ反射カバー６７をすき間なく覆って設けることにより、ランプ反射カバー６７の形状を容易に決めて固定することができる。また、ランプ反射カバー６７の形状を図９に示すような複雑な形状に形成したいときは、集光部１の固体の媒質の外側の形状を、形成したいランプ反射カバー６７の形状に合わせて形成し、その外側にランプ反射カバー６７をすき間なく覆って設けることにより容易に実現することができる。

【００４４】また、蛍光管３６は発光するとき、その中を電流が流れているが、その電流がランプ反射カバー６７を介して外部に漏れてしまう。要するに、蛍光管３６とランプ反射カバー６７と両者間の絶縁層により容量が生じてそこから電流が漏れる。従来は、蛍光管３６とランプ反射カバー６７との間の媒質は空気であったが、上記実施例では、蛍光管３６とランプ反射カバー６７との間の媒質はアクリル等の固体媒質であり（図８の実施例では空気層と固体媒質）、アクリル等は空気よりも絶縁性が高いため、漏れ電流を減少することができる。

【００４５】また、図１０は、本発明の別の実施例のバックライトを示す斜視図である。３７は導光板、３６は蛍光管、１は集光部、６７は集光部１の周囲に設けたランプ反射カバー、７７は蛍光管３６の両端に嵌合する凹部を有する蛍光管保持用のゴムブッシュ、７８はゴムブッシュ７７の蛍光管３６側の面に設けた反射面である。

【００４６】従来、ゴムブッシュ７７の蛍光管３６側の面は反射面になっていない。したがって、蛍光管３６から出射される光がゴムブッシュ７７の蛍光管３６側の面で吸収され、光が損失する。そこで、図１０の実施例では、ゴムブッシュ７７の蛍光管３６側の面に反射面７８を設けることにより、従来、ゴムブッシュ７７で吸収されていた光が反射面７８で反射されて吸収されなくなるため、光利用効率が向上する。反射面７８は上記ランプ反射カバー６７と同じ構成でよく、例えば、銀のシート、アルミ板、あるいは集光部１かゴムブッシュ７７に、銀やアルミニウム等を蒸着して構成する。

【００４７】また、ゴムブッシュ７７とランプ反射カバー６７との間には、図１０に示すようにすき間がある。したがって、蛍光管３６から出射される光がこのすき間から漏れ、光が損失する。そこで、図１１の実施例では、ゴムブッシュ７７と集光部１（あるいはランプ反射カバー６７）との間に、例えば反射シート等で形成した反射体７９を設けることにより（少なくとも反射面をランプ反射カバー６７側に形成する）、すき間がなくなり、従来、上記すき間から漏れていた光が反射体７９で反射されるため、光利用効率が向上する。

【００４８】以上説明したように、上記各実施例においては、蛍光管３６の周囲に設けた媒質により蛍光管３６から出射される光線の方向を制御できるため、蛍光管３６に再びもどって蛍光管３６に吸収される光の量を減少できるので、光利用効率を向上できる。したがって、バックライトの輝度が向上し、表示画面が明るくなり、表示品質が向上する。また、蛍光管３６の周囲にアクリル等の固体媒質を設けるので、蛍光管３６の周囲の絶縁性が良くなり、したがって、蛍光管３６の漏れ電流を減少でき、消費電力を低減できる。また、蛍光管３６の周囲が固体媒質で覆われているため、ランプ反射カバー６７の反射面の形状を複雑な形状にすることができる。これによっても、光利用効率を向上することができる。さらに、蛍光管３６を保持するゴムブッシュ７７の蛍光管３６側の面に反射面７８を設けるか、あるいは、ゴムブッシュ７７とランプ反射カバー６７との間に反射体７９を設けることにより、ゴムブッシュ７７により光が吸収されるのを防止し、あるいはランプ反射カバー６７とゴムブッシュ７７との間のすき間から光が漏れるのを抑制し、光利用効率を向上することができる。

【００４９】図１２は液晶表示素子６２と、この液晶表示素子６２を駆動するための駆動回路と、光源をコンパクトに一体にまとめた本発明が適用可能な単純マトリクス方式の液晶表示モジュール６３を示す分解斜視図である。液晶表示素子６２を駆動するＩＣ３４は、中央に液晶表示素子６２を嵌め込むための窓部を備えた枠状体のプリント基板３５に搭載される。液晶表示素子６２を嵌め込んだプリント基板３５はプラスチックモールドで形成された枠状体４２の窓部に嵌め込まれ、これに金属製フレーム４１を重ね、その爪４３を枠状体４２に形成されている切込み４４内に折り曲げることによりフレーム４１を枠状体４２に固定する。

【００５０】液晶表示素子６２の上下端に配置される冷陰極蛍光管３６、この冷陰極蛍光管３６からの光を液晶表示セル６０に均一に照射させるためのアクリル板からなる導光板３７、金属板に白色塗料を塗布して形成された反射板３８、導光板３７からの光を拡散する乳白色の拡散板３９が図１２の順序で、枠状体４２の裏側からその窓部に嵌め込まれる。冷陰極蛍光管３６を点灯する為のインバータ電源回路（図示せず）は枠状体４２の右側裏部に設けられた凹部（図示せず。反射板３８の凹所４５に対向する位置にある。）に収納される。拡散板３９、導光板３７、冷陰極蛍光管３６および反射板３８は、反射板３８に設けられている舌片４６を枠状体４２に設けられている小口４７内に折り曲げることにより固定される。

【００５１】この図に示すバックライトも、２本の蛍光管３６の周囲に導光体から成る集光部１が導光板３７と一体に設けられ、集光部１の各部の屈折率が蛍光管３６の光を導光板３７の方へ導光するように調整されており、光利用効率が向上されている。

【００５２】図１３は液晶表示モジュール６３を表示部

に使用したラップトップパソコンのブロックダイアグラム、図１４は液晶表示モジュール６３をラップトップパソコン６４に実装した状態を示す図である。このラップトップパソコン６４においては、マイクロプロセッサ４９で計算した結果を、コントロール用ＬＳＩ４８を介して液晶駆動用半導体ＩＣ３４で液晶表示モジュール６３を駆動するものである。

【００５３】図１５は本発明が適用可能な液晶表示装置の液晶表示素子６２を上側から見た場合の電極基板上における液晶分子の配列方向（例えばラビング方向）、液晶分子のねじれ方向、偏光板の偏光軸（あるいは吸収軸）方向、および複屈折効果をもたらす部材の光学軸方向を示し、図１６は液晶表示素子６２の要部斜視図を示す。

【００５４】液晶分子のねじれ方向１０とねじれ角$\theta$は、上電極基板１１上の配向膜２１のラビング方向６と下電極基板１２上の配向膜２２のラビング方向７および上電極基板１１と下電極基板１２の間に挟持される正の誘電異方性を有するネマチック液晶層５０に添加される旋光性物質の種類と量によって規定される。

【００５５】図１６において、液晶層５０を挟持する２枚の上、下電極基板１１、１２間で液晶分子がねじれたらせん状構造をなすように配向させるには、例えばガラスからなる透明な上、下電極基板１１、１２上の、液晶に接する、例えばポリイミドからなる有機高分子樹脂からなる配向膜２１、２２の表面を、例えば布などで一方向にこする方法、いわゆるラビング法が採られている。このときのこする方向、すなわちラビング方向、上電極基板１１においてはラビング方向６、下電極基板１２においてはラビング方向７が液晶分子の配列方向となる。このようにして配向処理された２枚の上、下電極基板１１、１２をそれぞれのラビング方向６、７が互いにほぼ１８０度から３６０度で交叉するように間隙$d_1$をもたせて対向させ、２枚の電極基板１１、１２を液晶を注入するための切欠け部、すなわち、液晶封入口５１を備えた枠状のシール剤５２により接着し、その間隙に正の誘電異方性をもち、旋光性物質を所定量添加されたネマチック液晶を封入すると、液晶分子はその電極基板間で図中のねじれ角$\theta$のらせん状構造の分子配列をする。なお３１、３２はそれぞれ例えば酸化インジウム又はＩＴＯ（Indium Tin Oxide）からなる透明な上、下電極である。このようにして構成された液晶セル６０の上電極基板１１の上側に複屈折効果をもたらす部材（以下複屈折部材と称す。藤村他「ＳＴＮ－ＬＣＤ用位相差フィルム」、雑誌電子材料１９９１年２月号第３７－４１頁）４０が配設されており、さらにこの部材４０および液晶セル６０を挟んで上、下偏光板１５、１６が設けられる。

【００５６】液晶５０における液晶分子のねじれ角$\theta$は１８０度から３６０度の範囲の値を採り得るが好ましくは２００度から３００度であるが、透過率－印加電圧カーブのしきい値近傍の点灯状態が光を散乱する配向となる現象を避け、優れた時分割特性を維持するという実用的な観点からすれば、２３０度から２７０度の範囲がより好ましい。この条件は基本的には電圧に対する液晶分子の応答をより敏感にし、優れた時分割特性を実現するように作用する。また優れた表示品質を得るためには液晶層５０の屈折率異方性$\Delta n_1$とその厚さ$d_1$の積$\Delta n_1 \cdot d_1$は好ましくは０.５$\mu$ｍから１.０$\mu$ｍ、より好ましくは０.６$\mu$ｍから０.９$\mu$ｍの範囲に設定することが望ましい。

【００５７】複屈折部材４０は液晶セル６０を透過する光の偏光状態を変調するように作用し、液晶セル６０単体では着色した表示しかできなかったものを白黒の表示に変換するものである。このためには複屈折部材４０の屈折率異方性$\Delta n_2$とその厚さ$d_2$の積$\Delta n_2 \cdot d_2$が極めて重要で、好ましくは０.４$\mu$ｍから０.８$\mu$ｍ、より好ましくは０.５$\mu$ｍから０.７$\mu$ｍの範囲に設定する。

【００５８】さらに、この液晶表示素子６２は複屈折による楕円偏光を利用しているので偏光板１５、１６の軸と、複屈折部材４０として一軸性の透明複屈折板を用いる場合はその光学軸と、液晶セル６０の電極基板１１、１２の液晶配列方向６、７との関係が極めて重要である。

【００５９】図１５で上記の関係の作用効果について説明する。図１５は、図１６の構成の液晶表示素子を上から見た場合の偏光板の軸、一軸性の透明複屈折部材の光学軸、液晶セルの電極基板の液晶分子軸配列方向の関係を示したものである。

【００６０】図１６において、５は一軸性の透明複屈折部材４０の光学軸、６は複屈折部材４０とこれに隣接する上電極基板１１の液晶分子軸配列方向、７は下電極基板１２の液晶配列方向、８は上偏光板１５の吸収軸あるいは偏光軸、９は下偏光板１６の吸収軸あるいは偏光軸であり、角度$\alpha$は上電極基板１１の液晶配列方向６と一軸性の複屈折部材４０の光学軸５とのなす角度、角度$\beta$は上偏光板１５の吸収軸あるいは偏光軸８と一軸性の透明複屈折部材４０の光学軸５とのなす角度、角度$\gamma$は下偏光板１６の吸収軸あるいは偏光軸９と下電極基板１２の液晶配列方向７とのなす角度である。

【００６１】ここで本明細書における角$\alpha$、$\beta$、$\gamma$の測り方を定義する。図２０において、複屈折部材４０の光学軸５と上電極基板の液晶配列方向６との交角を例にとって説明する。光学軸５と液晶配列方向６との交角は図２０に示す如く、$\phi_1$および$\phi_2$で表わすことが出来るが、本明細書においては$\phi_1$、$\phi_2$のうち小さい方の角を採用する。すなわち、図２０（ａ）においては$\phi_1 < \phi_2$であるから、$\phi_1$を光学軸５と液晶配列方向６との交角$\alpha$とし、図２０（ｂ）においては$\phi_1 > \phi_2$だから$\phi_2$を光学軸５と液晶配列方向６との交角$\alpha$とする。勿論$\phi_1$

＝$\phi_2$の場合はどちらを採っても良い。

【００６２】液晶表示素子においては角度α、β、γが極めて重要である。

【００６３】角度αは好ましくは５０度から９０度、より好ましくは７０度から９０度に、角度βは好ましくは２０度から７０度、より好ましくは３０度から６０度に、角度γは好ましくは０度から７０度、より好ましくは０度から５０度に、それぞれ設定することが望ましい。

【００６４】なお、液晶セル６０の液晶層５０のねじれ角θが１８０度から３６０度の範囲内にあれば、ねじれ方向１０が時計回り方向、反時計回り方向のいずれであっても、上記角α、β、γは上記範囲内にあればよい。

【００６５】なお、図１６においては、複屈折部材４０が上偏光板１５と上電極基板１１の間に配設されているが、この位置の代りに、下電極基板１２と下偏光板１６との間に配設しても良い。この場合は図１６の構成全体を倒立させた場合に相当する。

【００６６】図１７はねじれ角θ等の具体例を示す図である。図に示すように、液晶分子のねじれ角θは２４０度であり、一軸性の透明複屈折部材４０としては平行配向（ホモジェニアス配向）した、すなわちねじれ角が０度の液晶セルを使用した。ここで液晶層の厚みｄ(μｍ)と旋光性物質が添加された液晶材料のらせんピッチｐ(μｍ)の比ｄ／ｐは０．６７とした。配向膜２１、２２は、ポリイミド樹脂膜で形成しこれをラビング処理したものを使用した。このラビング処理を施した配向膜がこれに接する液晶分子を基板面に対して傾斜配向させるチルト角(pretilt角）は４度である。上記一軸性透明複屈折部材４０の$\Delta n_2 \cdot d_2$は約0.６μｍである。一方液晶分子が２４０度ねじれた構造の液晶層５０の$\Delta n_1 \cdot d_1$は約0.８μｍである。

【００６７】このとき、角度αを約９０度、角度βを約３０度、角度γを約３０度とすることにより、上、下電極３１、３２を介して液晶層５０に印加される電圧がしきい値以下のときには光不透過すなわち黒、電圧があるしきい値以上になると光透過すなわち白の白黒表示が実現できた。また、下偏光板１６の軸を上記位置より５０度から９０度回転した場合は、液晶層５０への印加電圧がしきい値以下のときには白、電圧がしきい値以上になると黒の、前記と逆の白黒表示が実現できた。

【００６８】図１８は図１７の構成で角度αを変化させたときの1／２００デューティで時分割駆動時のコントラスト変化を示したものである。角度αが９０度近傍では極めて高いコントラストを示していたものが、この角度からずれるにつれて低下する。しかも角度αが小さくなると点灯部、非点灯部ともに青味がかり、角度αが大きくなると非点灯部は紫、点灯部は黄色になり、いずれにしても白黒表示は不可能となる。角度βおよび角度γについてもほぼ同様の結果となるが、角度γの場合は前記したように５０度から９０度近く回転すると逆転の白黒表示となる。

【００６９】図１９はねじれ角θ等の他の具体例を示す図である。基本構造は図１６に示した具体例と同様である。ただし、液晶層５０の液晶分子のねじれ角は２６０度、$\Delta n_1 \cdot d_1$は約0.６５μｍ～0.７５μｍである点が異なる。一軸性透明複屈折部材４０として使用している平行配向液晶層の$\Delta n_2 \cdot d_2$は前記具体例と同じ約０．５８μｍである。液晶層の厚み$d_1$(μｍ)と旋光性物質が添加されたネマチック液晶材料のらせんピッチｐ(μｍ)との比はｄ／ｐ＝０．７２とした。

【００７０】このとき、角度αを約１００度、角度βを約３５度、角度γを約１５度とすることにより、最初の具体例と同様の白黒表示が実現できた。また下偏光板の軸の位置を上記値より５０度から９０度回転することにより逆転の白黒表示が可能である点もほぼ最初の具体例と同様である。角度α、β、γのずれに対する傾向も最初の具体例とほぼ同様である。

【００７１】上記いずれの具体例においても一軸性透明複屈折部材４０として、液晶分子のねじれのない平行配向液晶セルを用いたが、むしろ２０度から６０度程度液晶分子がねじれた液晶層を用いた方が角度による色変化が少ない。このねじれた液晶層は、前述の液晶層５０同様、配向処理が施された一対の透明基板の配向処理方向を所定のねじれ角に交差するようにした基板間に液晶を挟持することによって形成される。この場合、液晶分子のねじれ構造を挟む２つの配向処理方向の挟角の２等分角の方向を複屈折部材の光軸として取扱えばよい。また、複屈折部材４０として、透明な高分子フィルムを用いても良い（この際一軸延伸のものが好ましい）。この場合高分子フィルムとしてはＰＥＴ（ポリエチレン　テレフタレート）、アクリル樹脂フィルム、ポリカーボネイトが有効である。

【００７２】さらに以上の具体例においては複屈折部材は単一であったが、図１６において複屈折部材４０に加えて、下電極基板１２と下偏光板１６との間にもう一枚の複屈折部材を挿入することもできる。この場合はこれら複屈折部材の$\Delta n_2 \cdot d_2$を再調整すればよい。

【００７３】ただし、図２１に示す如く、上電極基板１１上に赤、緑、青のカラーフィルタ３３Ｒ、３３Ｇ、３３Ｂ、各フィルター同志の間に光遮光膜３３Ｄを設けることにより、多色表示が可能になる。図１８に前記具体例における液晶分子の配列方向、液晶分子のねじれ方向、偏光板の軸の方向および複屈折部材の光学軸の関係を示す。

【００７４】なお、図２１においては、各フィルタ３３Ｒ、３３Ｇ、３３Ｂ、光遮光膜３３Ｄの上に、これらの凹凸の影響を軽減するため絶縁物からなる平滑層２３が形成された上に上電極３１、配向膜２１が形成されている。

【００７５】以上説明したように、上記具体例によれば、優れた時分割駆動特性を有し、さらに白黒および多色表示を可能にする電界効果型液晶表示素子を実現することができる。

【００７６】以上本発明を実施例に基づいて具体的に説明したが、本発明は上記実施例に限定されるものではなく、その要旨を逸脱しない範囲において種々変更可能であることは勿論である。例えば、集光部１の外側の形状、空洞７６の形状、集光部１や導光板３７の材質、導光板３７の形状、ランプ反射カバー６７の構成等は上記実施例に示したものの他、種々の物を使用可能である。例えば、集光部１の外側の形状を蛍光管３６の中心線と垂直方向の断面形状がベジェ曲線を成すように形成してもよい。また、上記実施例では、ランプ反射カバー６７として反射シートを用いたが、プラスチック等を用いてランプ反射カバーを所定の形状に成型した後、その内面に銀等を蒸着することにより形成したり、あるいは平板に反射シート等の反射面を設けた後、所定の形状に成型して製造してもよい。また、図８の実施例において、空洞７６は空気層であったが、空洞７６に窒素等のガスを充填してもよい。さらに、本発明は導光板を含んでなるバックライトを有する液晶表示装置に適用可能であり、単純マトリクス方式の液晶表示装置にも、薄膜トランジスタ等をスイッチング素子として用いたアクティブマトリクス方式の液晶表示装置にも適用可能であることは言うまでもない。

【００７７】

【発明の効果】以上説明したように、本発明によれば、蛍光管の周囲に導光板と連続する固体の媒質を設け、また、蛍光管から出射される光線の方向を制御することにより、光利用効率を向上できる。したがって、バックライトの輝度が向上し、表示画面が明るくなり、表示品質が向上する。また、蛍光管の周囲に固体媒質を設けるので、蛍光管の周囲の絶縁性を高くすることができ、蛍光管の漏れ電流を減少でき、消費電力を低減できる。また、蛍光管の周囲が固体媒質で覆われているため、ランプ反射カバーの形状を良好に形成、保持でき、光利用効率を向上できる。

【図面の簡単な説明】

【図１】本発明の一実施例の液晶表示装置のバックライトを示す断面図である。

【図２】本発明の一実施例の液晶表示装置のバックライトにおいて、集光部の屈折率の位置依存性により、蛍光管から出射した光が導光している様子を示す図である。

【図３】本発明の一実施例の液晶表示装置のバックライトにおいて、蛍光管の中心からの半径方向の距離と、蛍光管周辺の集光部（媒質）の屈折率との関係を示す図である。

【図４】本発明の一実施例の液晶表示装置のバックライトにおいて、集光部（媒質）の端面からの距離と、蛍光管周辺の前記集光部の屈折率との関係を示す図である。

【図５】同一の屈折率の固体媒質を層状に重ねて、集光部の屈折率を階段状に変化させた具体的な例を示す要部断面図である。

【図６】同一の屈折率の固体媒質を層状に重ねて、集光部の屈折率を階段状に変化させた具体的な例を示す要部断面図である。

【図７】同一の屈折率の固体媒質を層状に重ねて、集光部の屈折率を階段状に変化させた具体的な例を示す要部断面図である。

【図８】本発明の一実施例の液晶表示装置のバックライトにおいて、蛍光管の周囲の空洞により、蛍光管から出射した光が導光している様子を示す要部断面図である。

【図９】本発明の一実施例の液晶表示装置のバックライトにおいて、複雑なランプ反射カバーの形状でもその形状を容易に形成、保持することができることを示す要部断面図である。

【図１０】本発明の一実施例の液晶表示装置のバックライトの斜視図である。

【図１１】本発明の一実施例の液晶表示装置のバックライトの斜視図である。

【図１２】本発明が適用可能な単純マトリクス方式の液晶表示モジュールの一例の分解斜視図である。

【図１３】ラップトップパソコンの一例のブロックダイアグラムである。

【図１４】ラップトップパソコンの一例の斜視図である。

【図１５】本発明が適用可能な単純マトリクス方式の液晶表示素子における液晶分子の配列方向、液晶分子のねじれ方向、偏光板の軸の方向および複屈折部材の光学軸の関係の一例を示した説明図である。

【図１６】液晶表示素子の一例の要部分解斜視図である。

【図１７】別の例の液晶表示素子における液晶分子のねじれ方向、偏光板の軸の方向および複屈折部材の光学軸の関係を示した説明図である。

【図１８】液晶表示素子の図１５の例についてのコントラスト、透過光色－交角$\alpha$特性を示すグラフである。

【図１９】さらに別の例の液晶表示素子における液晶分子の配列方向、液晶分子のねじれ方向、偏光板の軸の方向および複屈折部材の光学軸の関係を示した説明図である。

【図２０】交角$\alpha$、$\beta$、$\gamma$の測り方を説明するための図である。

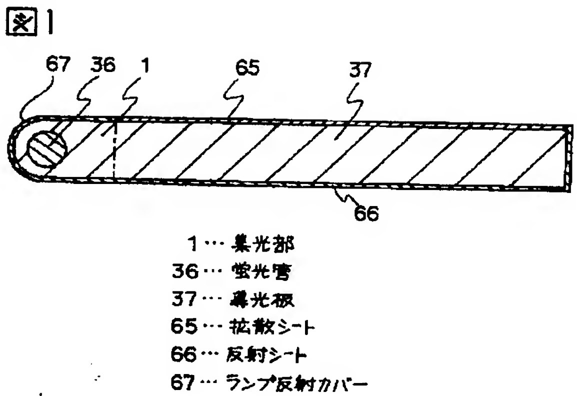
【図２１】液晶表示素子の上電極基板部の一例の一部切欠斜視図である。

【符号の説明】

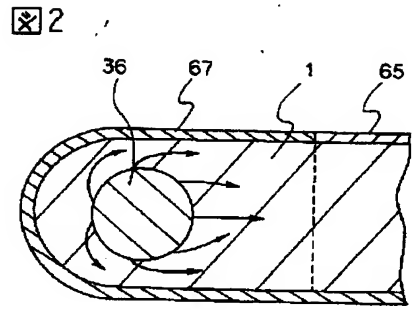
１…集光部、３６…蛍光管、３７…導光板、６５…拡散シート、６６…反射シート、６７…ランプ反射カバー、７６…空洞、７７…ゴムブッシュ、７８…反射面、７９

…反射体。

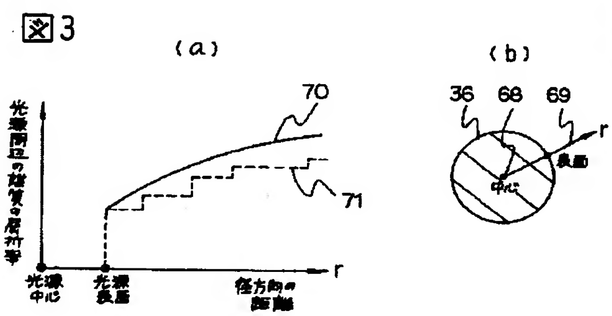
【図１】



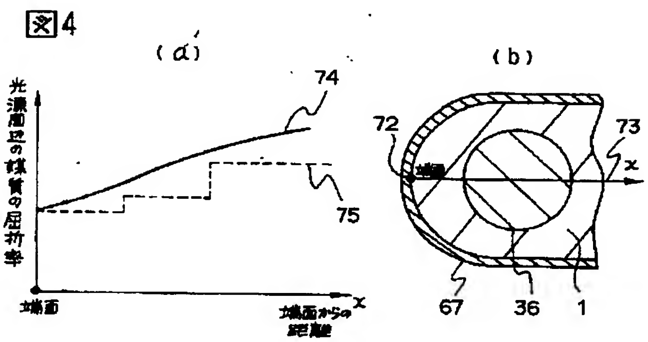

【図２】



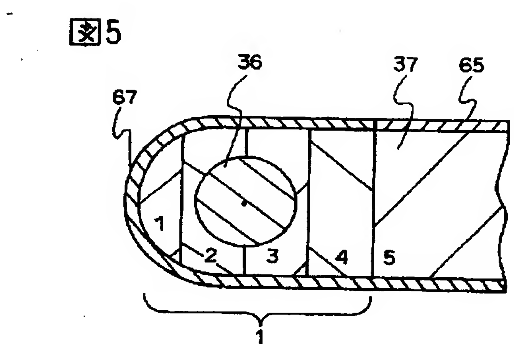

【図３】



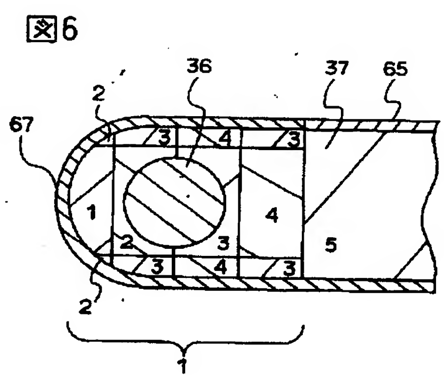

【図４】



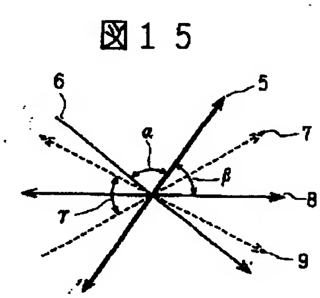

【図５】




【図６】

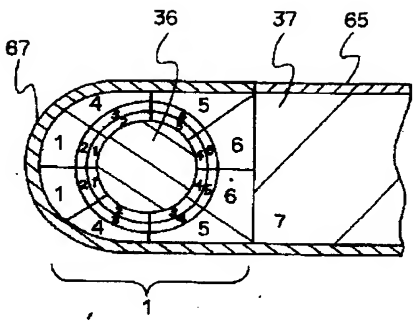



【図１５】



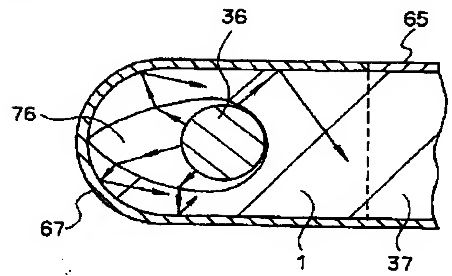
【図7】

図7



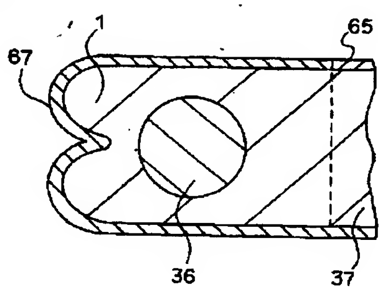

【図8】

図8



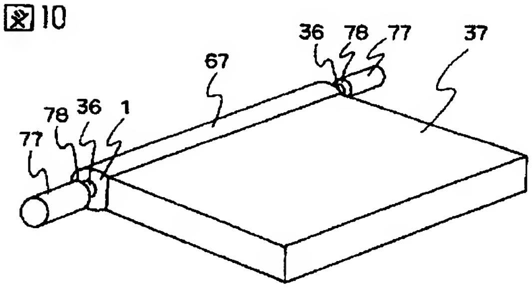

【図9】

図9



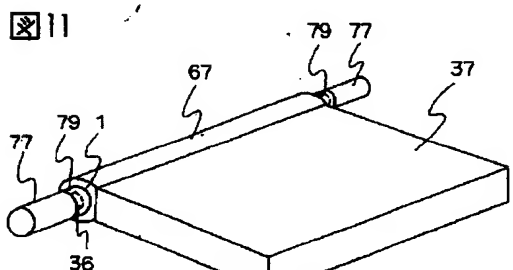

【図10】

図10



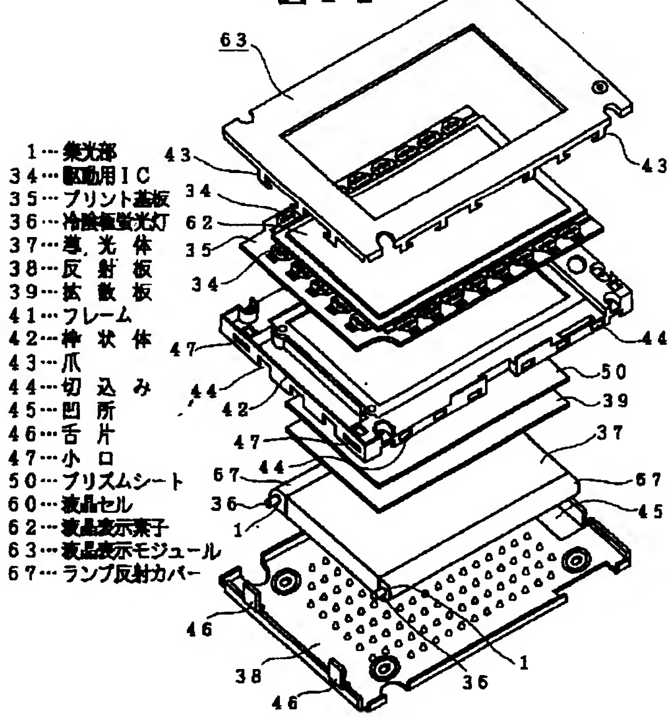

【図11】

図11



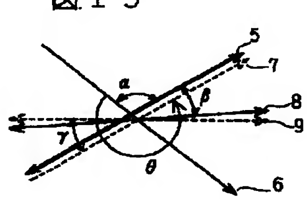

【図12】

図１２



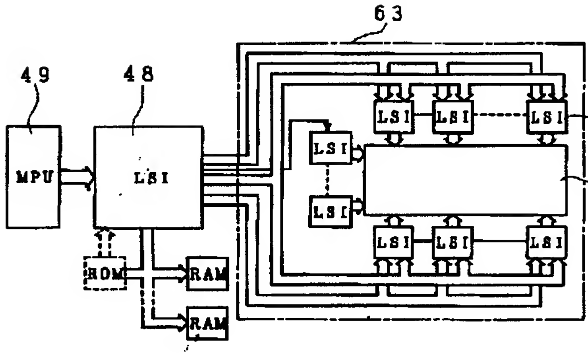

【図19】

図１９



【図13】

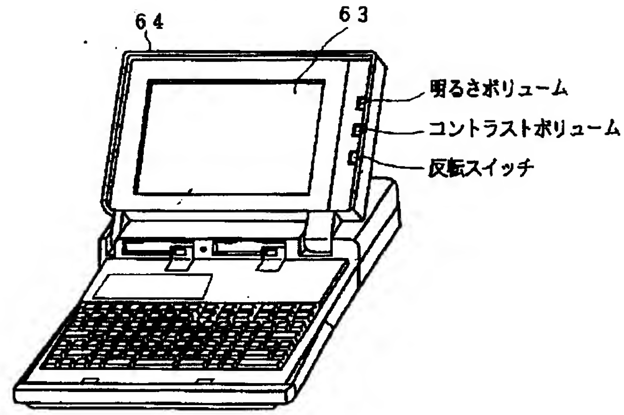
図13




34…駆動用IC
48…コントロール用LSI
49…マイクロプロセッサユニット
62…液晶表示素子
63…液晶表示モジュール
64…ラップトップパソコン

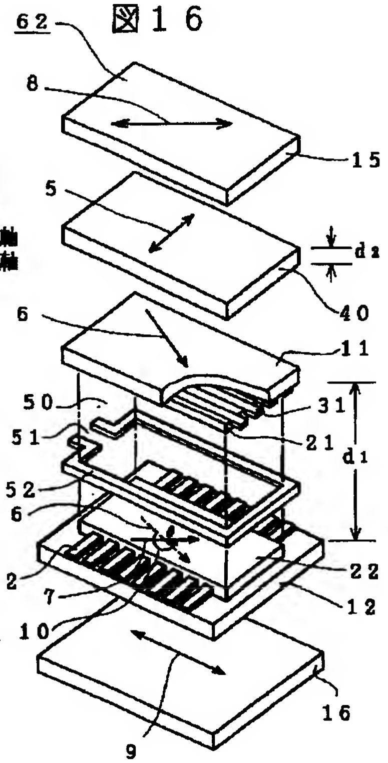
【図14】

図14




【図16】

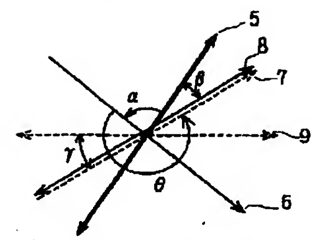
図16




5…一軸性複屈折部材の光学軸
6…上電極基板の液晶配列方向
7…下電極基板の液晶配列方向
8…上偏光板の偏光軸又は吸収軸
9…下偏光板の偏光軸又は吸収軸
10…液晶分子のねじれ方向
11…上電極基板
12…下電極基板
15…上偏光板
16…下偏光板
21…配向膜
22…配向膜
31…上電極
32…下電極
40…複屈折部材
50…液晶層
51…液晶封入口
52…シール材
60…液晶セル
62…液晶表示素子

【図17】

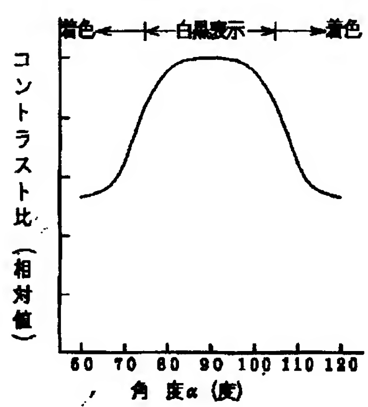
図17




5…一軸性複屈折部材の光学軸
6…上電極基板の液晶配列方向
7…下電極基板の液晶配列方向
8…上偏光板の偏光軸又は吸収軸
9…下偏光板の偏光軸又は吸収軸

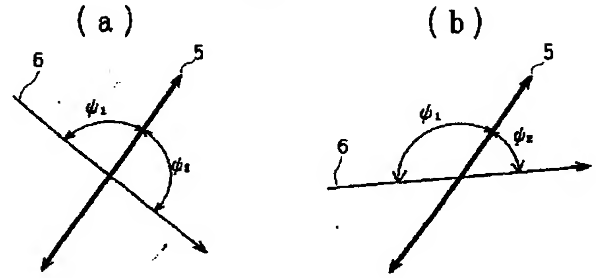
【図18】

図18



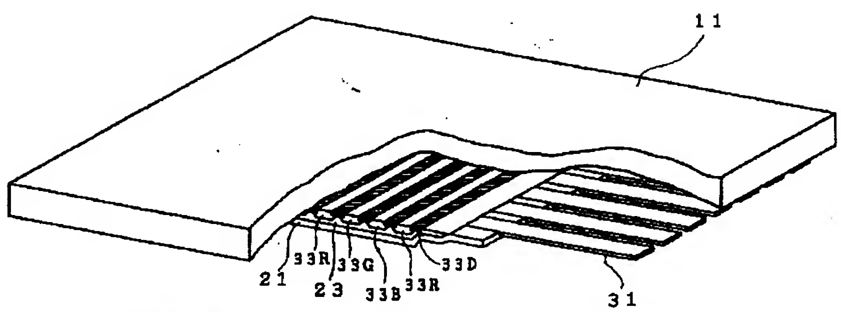
【図２０】

図２０




【図２１】

図２１




１１…上電極基板
２１…配向膜
２３…平滑層
33D…光遮光膜
33R…赤フィルタ
33G…緑フィルタ
33B…青フィルタ